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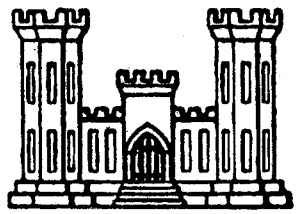
CORPS OF ENGINEERS

MISSISSIPPI RIVER COMMISSION

MODEL STUDY OF SLUICES FOR FALL RIVER DAM, FALL RIVER, KANSAS



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MODEL STUDY OF SLUICES FOR FALL RIVER DAM, FALL RIVER, KANSAS

SYNOPSIS

1. The model study of sluices for Fall River Dam was conducted to determine the hydraulic performance of alternate sluice designs discharging into a stilling basin developed from consideration of spillway flow. The alternate sluice designs consisted of a sluice with its exit invert at stilling basin elevation and a sluice with its exit invert 13 ft above stilling basin elevation and containing a tetrahedral deflector. Five variations of the latter design were studied. The stilling basin consisted of a horizontal floor 105 ft long, a stepped end sill 7 ft high, and two rows of 8-ft-high baffles.

2. It was determined from the model study that performance of the deflector-type sluice was the more favorable. Also, it was found that special treatment of the flared sidewalls of the deflector-type outlet portal was required to obtain satisfactory pressure conditions thereon. The sluice design designated type 6 in this report, details of which are shown on plate 37, is recommended for installation in the prototype.

PART I: INTRODUCTION

Authority

3. Authority to undertake the model study of Fall River Dam was requested by the District Engineer, Tulsa District, Tulsa, Oklahoma, in a letter dated 9 May 1945, to the Chief of Engineers, through the Division Engineer, Southwestern Division. Authority was granted by the Chief of Engineers in an indorsement, dated 28 May 1945, to the above letter.

Personnel

4. The model study was accomplished in the Structures Branch, Hydraulics Division, Waterways Experiment Station. Chief of the Hydraulics Division is Mr. E. P. Fortson, Jr., Engineer, and Chief of the Structures Branch is Mr. F. R. Brown, Engineer. The Project Engineer in charge of the model was Mr. C. Kestenbaum, Engineer, who worked under the supervision of Mr. T. E. Murphy, Engineer.

5. Mr. Harold W. Feldt, Chief, Hydraulic Design Section, and Mr. R. H. Berryhill, Assistant Chief, Hydraulic Design Section, of the Tulsa District Office, visited the Experiment Station in an advisory capacity at intervals during the testing program.

The Prototype

6. The dam is located on Fall River in Greenwood County, Kansas, about four miles northwest of the town of Fall River, about 73 miles south of Emporia, and about 46 miles northwest of Independence (plate 1).

7. The dam will be a rolled earth-fill structure with rock-protected slopes. The structure will have a length of 5545 ft, and a maximum height of 94 ft above the valley floor. The top of the dam will have a width of 28 ft, while the maximum width at the base will be over 700 ft (plate 2).

8. A gated concrete spillway having a total length of 470 ft will be located in and adjacent to the present river channel. Spillway capacity sufficient to discharge a flow of about three times the peak flow of the June 1923 flood (219,000 cfs) has been selected to insure safety of the dam.

9. Flow over the spillway will be controlled by eight tainter gates, 50 ft wide by 25 ft high, each of which will be operated by individual electric-motored hoists located under the spillway bridge. Additional regulation of outflow from the dam will be provided by seven gate-controlled sluices, 5.0 ft wide by 8.5 ft high, located through the intermediate piers of the spillway. A 30-in.-diameter conduit through the spillway will be utilized for releasing flows of small magnitude from the reservoir.

The Problem

10. Hydraulic conditions are such at Fall River Dam that development by established equations of a stilling basin for dissipation of energy of flow over the spillway was possible. However, existing data were not sufficient to predict accurately the performance of this stilling basin with respect to dissipation of energy of sluice flow. Alternate sluice designs were proposed; one in which the invert of the

sluice outlet was at the elevation of the stilling basin floor, and the other in which the invert of the sluice outlet was 13 ft above the stilling basin floor and which contained a deflector for spreading the flow from the sluice.

Purpose of the Model Study

11. The general purpose of the model study was to examine the hydraulic performance of the two sluice designs, and to provide means for correcting any uneconomic, unsafe, or undesirable conditions found to exist in the design more favorable for Fall River conditions.

The Model

12. The model, a general view of which is shown by photograph 1, was built to the linear scale ratio, model to prototype, of 1:20. There were reproduced in the model three sluices, including the bell-mouth intake, sluice gates, air vents, and exit portals, that portion of the spillway face below elevation 935*, a 256-ft-wide section of the stilling basin, and 200 ft of the exit channel. The reservoir area was represented by a reinforced concrete headbay of sufficient size and properly baffled to permit quiet approach conditions to the model. The original design sluices were fabricated of sheet metal; exit portals of subsequent designs were fabricated of plexiglass; air vents were fabricated of sheet metal; and the gates were molded of plexiglass. The spillway face was molded in cement mortar to sheet metal templets. The stilling basin was molded in cement mortar to wood screeds which were afterwards

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* All elevations are referred to feet above mean sea level.

used as nailing strips. That portion of the model downstream from the stilling basin was molded flat in sand for scour tests. For velocity tests the same bed was rendered immovable by a thin coating of cement mortar.

PART II: NARRATIVE OF TESTS

13. Tests were conducted with the reservoir at three elevations, power pool 950, later changed to 948.5, spillway crest 962.5, and top of tainter gate 987.5. Tailwater elevations were set in accordance with the tailwater rating curve shown on plate 3.

Type-1 Sluice and Type-1 Stilling Basin

14. The type-1 sluice had its entrance invert at elevation 915, extended horizontally a distance of about 31 ft from the face of the dam, and then sloped downward to the toe of the spillway. Details of the type-1 sluice are shown on plate 4, while photograph 2 is a view of the model sluice. The type-1 stilling basin consisted of a 105-ft-long horizontal apron at elevation 902, with two rows of 8-ft-high baffle piers and a 7-ft-high stepped end sill. Details of the type-1 stilling basin are shown on plate 5.

15. Rating curves as determined in the model are shown on plate 6. It is to be noted that considerably more flow was passed through the model than expected. Pressures throughout the type-1 sluice for all discharge conditions were positive (table 1).

16. Photograph 3 shows views of action in the type-1 stilling basin produced by flow from one type-1 sluice. At the low tailwater elevations existing the jet from the sluice remained concentrated until it impinged against the upstream row of baffle piers. A standing wave of turbulent flow was formed over this row of baffle piers. However, the jet from the sluice was well dispersed before it passed over the end sill. Velocities over the end sill and scour produced by these

velocities are shown on plates 7 to 12. With the reservoir pool at elevation of the top of the tainter gates, 987.5, maximum velocity observed over the end sill was 13 ft per sec. Velocities as high as 11 ft per sec were measured over the end sill with one sluice operating and the reservoir at power pool, 950. Flow conditions produced by three type-1 sluices discharging into the type-1 stilling basin are shown by photograph 4a. Photograph 4b shows conditions simulating discharge from seven sluices. Velocities and erosion tendencies were not as great as those produced by the operation of a single sluice. See plates 13 to 16.

Training walls

17. The stilling basin in the model represented a section of the prototype stilling basin 260 ft wide. Since the sluices are 60 ft apart on centers across the entire width of the spillway, flow from three sluices, for conditions representing discharge from seven sluices, should be confined to a 180-ft-wide section of the stilling basin. In order to reproduce natural conditions, training walls were installed in the type-1 stilling basin to confine the flow from three sluices to a 180-ft-wide section of the stilling basin. These walls rose to elevation 930 and extended 10 ft downstream from the end sill.

18. For comparable discharge conditions the confining effect of the training walls produced slightly higher velocities over the end sill. Compare plates 17 and 15. When tested with a sand bed representing the exit channel, tests of one-hour duration eroded the bed to a maximum depth of 4 ft below the top of the end sill both with and without the training walls installed. Compare plates 18 and 16. Therefore, it was concluded that training walls had no appreciable effect on flow

characteristics in the stilling basin. Compare photographs 4b and c.

19. Since tests on the type-1 sluice indicated that maximum velocities over the end sill and erosion tendencies in the exit channel occurred during a condition of one sluice operating, and since the training walls produced only minor changes in flow characteristics for the less critical condition of all seven sluices operating, it was decided to conduct all subsequent tests without training walls.

Type-2 Sluice and Type-1 Stilling Basin

20. The type-2 sluice had its entrance invert at elevation 915 and extended horizontally through the spillway. The exit portal consisted of a tetrahedral deflector on the floor of the sluice and flared sidewalls. Details of the type-2 sluice are shown on plate 19. Photograph 5 is a view of the model sluice while photograph 6 is a view of the sluice outlet and type-1 stilling basin installed in the model.

21. Rating curves for the type-2 sluice are presented on plate 20. With the pool at the top of the tainter gates, 987.5, discharge through the type-2 sluice was about 5 per cent greater than that through the type-1 sluice. Pressures in the downstream portion of the sluice are recorded in table 2. A minimum pressure of -17 ft was observed on the wall of the outlet portal.

22. The deflector-type outlet portal of the type-2 sluice spread the flow issuing from the sluice into a thin sheet of water of considerable width. In the outlet portal itself the jet sprang free of the flared portal sidewalls near the face of the spillway. With only one sluice in operation the sheet of water struck against the first row of

baffles and formed a turbulent standing wave (photograph 7a). Maximum velocities of 14 ft per sec were observed in the exit channel. With discharge from all sluices simulated the sluice outlet portal was submerged but satisfactory flow conditions existed in the stilling basin (photograph 7b). Velocities and erosion tendencies were negligible. For comparable conditions velocities against the upstream row of baffles, velocities over the end sill and erosion tendencies in the exit channel were less for the type-2 sluice than for the type-1 sluice. Compare plates 21 to 24 with plates 11, 12, 15, and 16.

Type-2 Sluice and Type-2 Stilling Basin

23. The type-2 stilling basin contained the same elements as did the type-1 stilling basin, but in order to obtain additional tailwater cushion the two rows of baffles were moved 16 ft downstream. Details of the type-2 stilling basin are shown on plate 5.

24. With one sluice operating, the standing wave over the first row of baffles was not as high as in the type-1 stilling basin and the piers appeared to be subject to less impact. Compare photographs 8c and 7a. Flow conditions in the type-2 stilling basin produced by flow from the type-2 sluice are shown on photographs 8 and 9. Scour and velocity data are presented on plates 25 to 34. Maximum velocities were produced in the exit channel by a condition of only one sluice operating. With the reservoir at the top of the tainter gates, velocities of 16 ft per sec were observed in the exit channel, while the reservoir at spillway crest and power pool produced velocities of 13 ft per sec and 9 ft per sec, respectively. Velocities and erosion tendencies produced by the

type-2 sluice discharging into the type-2 stilling basin were slightly greater than those produced by the type-2 sluice discharging into the type-1 stilling basin. This probably was due to the reduced impact on the baffle piers. Compare plates 29 and 30 with plates 21 and 22.

25. In order to furnish an indication of expected stilling action with sluice gates partially opened, the gates in sluices 1 and 3 were opened approximately halfway to permit a discharge of 2040 cfs with the reservoir at spillway crest. Flow characteristics for this condition are shown on photograph 9c. Maximum velocities of 4 ft per sec were observed along the bed of the exit channel. With the reservoir at spillway crest and 2040 cfs discharging through one sluice, maximum velocities of 13 ft per sec were recorded along the bed of the exit channel. Compare plates 35 and 27.

Type-3 Sluice

26. Reference is made to plate 19 showing details of the type-2 sluice. The type-3 sluice was identical to the type-2 sluice, except the height of the deflector was increased from 4 ft to 5 ft.

27. Flow conditions were similar to those produced by the type-2 sluice. Pressures as low as -19 ft were measured on the walls of the outlet portal (table 3). Inasmuch as there was no noticeable improvement in stilling basin action and pressure conditions in the outlet portal were still unfavorable, this design was abandoned.

Study of Unconfined Deflected Jet

28. Since the deflector used in the type-2 sluice spread the jet from the sluice into a horizontal sheet of water and thereby produced

satisfactory flow conditions in the stilling basin, the only objection to the type-2 or -3 designs was the existence of undesirable negative pressures in the outlet portal. It was thought that a satisfactory design could be developed by shaping the sidewalls of the portal to conform with the shape taken by the jet from the sluice as it passed over the deflector and began to spread. To study the shape of the unconfined deflected jet, the sidewalls and top of the outlet portal were removed, leaving only the floor and deflector on the end of the sluice. Cross sections of the deflected jet were then taken at 2-ft intervals over the deflector as shown on plate 36. A study of the cross sections indicated that favorable results probably would be obtained from a design in which the portal sidewalls were warped surfaces composed of straight elements lying on vertical planes perpendicular to the horizontal axis of the sluice. The upper guide line for each element is the tangent line extending from the ceiling corner of the sluice proper. The lower guide line for each element is the floor plan of the type-2 sluice. Accordingly, the types 4, 5, and 6 sluices were developed.

Types 4 and 5 Sluices

29. The type-4 sluice was identical to the type-6 sluice (plate 37), except the apex of the deflector was 1.7 ft downstream and the roof constriction was 0.35 ft. The type-5 sluice was identical to the type-4 sluice except the roof constriction was 0.50 ft.

30. Flow conditions produced by the types 4 and 5 sluices were similar to those produced by the type-2 sluice. Pressure data are contained in tables 4 and 5. Although pressure conditions were improved

over the types 2 and 3 sluices, undesirable pressures as low as -12 ft were still measured on the walls of each sluice.

Type-6 Sluice and Type-2 Stilling Basin

31. Details of the type-6 sluice are shown on plate 37. Photograph 10 is a view of the model. Since critical conditions obtained in all preceding tests with only one sluice discharging, only one type-6 sluice was installed in the model.

32. Rating curve for the type-6 sluice is shown on plate 38. Head-discharge relations were practically the same as those observed with the type-2 sluice and are presented on plate 20. Additional back pressure caused by moving the apex of the deflector 1.7 ft upstream produced satisfactory pressure conditions in the outlet portal. A minimum pressure of -5 ft was recorded. Pressure data are contained in table 6.

33. Flow conditions produced by the type-6 sluice were similar to those produced by the type-2 sluice, except that in the type-6 sluice outlet portal the jet from the sluice remained against the portal sidewalls to their intersection with the face of the spillway. Flow conditions in the stilling basin are shown by photograph 11. In general, velocities and erosion tendencies produced by the type-6 sluice also were about equal to those produced by the type-2 sluice. Compare plates 39 to 44 with plates 25 to 30.

Pressures on Baffle Piers

34. In order to furnish a basis for determining possible damage to the baffle piers due to the impact of sluice discharge, instantaneous pressure measurements were made on the upstream face of baffle piers in

the type-2 stilling basin directly in front of the type-1 and type-6 sluices. These pressures were measured by means of an electric pressure cell and recorded by an oscillograph. Tests were run over a period of about 33 seconds for each sluice to insure representative results. Data were taken with only one sluice operating, since, as mentioned previously, tests had indicated this condition to be most critical.

35. Presented on plate 45 are portions of the pressure records obtained. These portions of the pressure records include the highest pressure recorded for each sluice. Maximum pressure recorded was in front of the type-1 sluice and was equal to a static head of 65 ft of water. The highest pressure recorded in front of the type-6 sluice was equal to a static head of 50 ft of water. Average pressure on the face of the baffle pier produced by flow from the type-1 sluice was about double that produced by flow from the type-6 sluice.

PART III: DISCUSSION

36. It is recommended that the type-6 sluice and type-2 stilling basin be constructed in the prototype.

37. The model tests demonstrated that for low tailwater conditions that will obtain when only one or two of the sluices are operating, the deflector-type outlet portal definitely is superior in dissipating energy to the exit portal with its invert at stilling basin elevation. At the higher tailwater conditions that will obtain when all sluices are discharging, either type of the outlet portals tested will perform satisfactorily with respect to energy dissipation.

38. Of the five deflector-type outlet portals tested, type-6 is the only one in which pressure conditions in the portal were satisfactory. All five were about equal with respect to energy dissipation.

39. The type-2 stilling basin is recommended not because it is superior to the type-1 stilling basin from an energy dissipation standpoint but because in the type-2 stilling basin the tailwater cushioned the flow from the deflector-type outlets prior to its striking against the baffles.

40. The emphasis that was given in these tests to impact against the baffle piers was due to the belief that this impact might cause erosion of the concrete baffle piers. Also, it is probable that with some, but not all, of the sluices operating debris from the exit channel will be pulled into the stilling basin by eddies. The abrasive damage caused by this debris will be proportional to the impact against the baffles.

41. An operation schedule whereby several sluices are operated

at partial gate openings, rather than one sluice at full gate opening, would be desirable from an energy dissipation standpoint.

TABLE 1

MODEL STUDY OF SLUICES

FALL RIVER DAM

Pressures

Type 1 Design

Piezometer Number	Piezometer Zero	Discharge - 2400 cfs Pool Elev - 987.5		Discharge - 1900 cfs Pool Elev - 962.5		Discharge - 1640 cfs Pool Elev - 950.0	
		Piezometer Reading	Pressure	Piezometer Reading	Pressure	Piezometer Reading	Pressure
1	925.5	975.0	49.5	954.5	29.0	945.0	19.5
2	925.5	974.0	48.5	953.5	28.0	944.0	18.5
3	925.5	975.5	50.0	955.0	29.5	945.0	19.5
4	923.0	973.5	50.5	953.0	30.0	943.5	20.5
5	919.5	971.0	51.5	952.0	32.5	942.5	23.0
6	916.0	972.0	56.0	952.5	36.5	943.0	27.0
7	914.5	972.0	57.5	952.0	37.5	943.0	28.5
8	923.5	936.0	12.5	929.0	5.5	926.0	2.5
9	919.5	938.5	19.0	930.5	11.0	927.0	7.5
10	915.0	938.5	23.5	930.0	15.0	927.0	12.0
11	923.5	936.5	13.0	929.0	5.5	926.5	3.0
12	923.5	936.5	13.0	929.5	6.0	926.5	3.0
13	920.5	936.0	15.5	929.0	8.5	926.0	5.5
14	917.5	936.0	18.5	929.0	11.5	926.0	8.5
15	915.0	936.5	21.5	929.5	14.5	926.5	11.5
16	921.5	941.5	20.0	932.5	11.0	928.5	7.0
17	917.5	933.0	15.5	927.0	9.5	924.5	7.0
18	913.5	925.5	12.0	922.0	8.5	921.0	7.5
19	918.5	921.0	2.5	919.5	1.0	919.0	0.5
20	918.5	919.0	0.5	918.5	0.0	918.5	0.0
21	916.0	920.0	4.0	919.0	3.0	918.5	2.5
22	913.5	919.5	6.0	918.5	5.0	918.0	4.5
23	911.0	921.0	10.0	919.5	8.5	918.5	7.5

NOTE: Pressures are recorded in prototype ft of water to the nearest half ft.
Locations of piezometers are shown on plate 4.

TABLE 2

MODEL STUDY OF SLUICES

FALL RIVER DAM

Pressures

Type 2 Design

Piezometer Number	Piezometer Zero	Discharge - 2520 cfs Pool Elev - 987.5		Discharge - 2040 cfs Pool Elev - 962.5		Discharge - 1640 cfs Pool Elev - 948.5	
		Piezometer Reading	Pressure	Piezometer Reading	Pressure	Piezometer Reading	Pressure
16	923.5	928.5	5.0	926.0	2.5	925.0	1.5
17	923.5	928.0	4.5	925.5	2.0	924.5	1.0
18	920.5	929.0	8.5	926.0	5.5	924.5	4.0
19	917.5	929.0	11.5	926.0	8.5	924.5	7.0
20	915.0	929.0	14.0	926.0	11.0	924.5	9.5
21	923.5	927.0	3.5	925.0	1.5	922.0	-1.5
22	923.5	926.0	2.5	924.5	1.0	922.5	-1.0
23	920.5	927.0	6.5	925.0	4.5	924.0	3.5
24	917.5	927.0	9.5	924.5	7.0	923.5	6.0
25	915.0	926.0	11.0	924.0	9.0	923.0	8.0
26	923.5	934.0	10.5	930.0	6.5	927.5	4.0
27	923.5	934.0	10.5	930.0	6.5	927.5	4.0
28	920.5	925.5	5.0	924.0	3.5	923.0	2.5
29	917.5	919.5	2.0	920.0	2.5	920.0	2.5
30	922.5	929.5	7.0	926.5	4.0	925.0	2.5
31	922.5	930.0	7.5	927.0	4.5	925.5	3.0
32	922.5	928.5	6.0	926.0	3.5	925.0	2.5
33	922.5	925.5	3.0	924.5	2.0	924.0	1.5
34	919.0	917.5	-1.5	919.0	0.0	919.0	0.0
35	919.0	920.0	1.0	919.5	0.5	920.0	1.0
36	919.0	-----	----	-----	----	-----	----
37	916.0	918.5	2.5	919.0	3.0	920.0	4.0
38	916.0	902.0	-14.0	910.0	-6.0	914.0	-2.0
39	916.0	899.0	-17.0	906.5	-9.5	911.0	-5.0
40	916.0	910.5	-5.5	914.5	-1.5	916.0	0.0
41	920.5	-----	----	-----	----	-----	----

NOTE: Pressures are recorded in prototype ft of water to the nearest half ft.

Locations of piezometers are shown on plate 19.

TABLE 3

MODEL STUDY OF SLUICES

FALL RIVER DAM

Pressures

Type 3 Design

Piezometer Number	Piezometer Zero	Discharge - 2485 cfs Pool Elev - 987.5		Discharge - 1960 cfs Pool Elev - 962.5		Discharge - 1575 cfs Pool Elev - 948.5	
		Piezometer Reading	Pressure	Piezometer Reading	Pressure	Piezometer Reading	Pressure
16	923.5	931.0	7.5	927.5	4.0	926.0	2.5
17	923.5	930.5	7.0	927.0	3.5	925.5	2.0
18	920.5	931.5	11.0	928.0	7.5	926.0	5.5
19	917.5	931.0	13.5	928.0	10.5	925.5	8.0
20	915.0	931.5	16.5	928.0	13.0	926.0	11.0
21	923.5	929.0	5.5	926.0	2.5	925.0	1.5
22	923.5	928.0	4.5	925.5	2.0	924.5	1.0
23	920.5	929.5	9.0	926.5	6.0	925.0	4.5
24	917.5	929.5	12.0	926.5	9.0	925.0	7.5
25	915.0	929.0	14.0	926.0	11.0	924.5	9.5
26	923.5	936.0	12.5	931.0	7.5	928.0	4.5
27	923.5	936.0	12.5	930.5	7.0	927.5	4.0
28	920.5	926.0	5.5	924.5	4.0	923.5	3.0
29	917.5	921.0	3.5	921.5	4.0	921.0	3.5
30	922.5	931.0	8.5	927.5	5.0	925.5	3.0
31	922.5	931.0	8.5	928.0	5.5	926.0	3.5
32	922.5	929.0	6.5	926.5	4.0	925.0	2.5
33	922.5	926.0	3.5	924.5	2.0	924.0	1.5
34	919.0	915.0	-4.0	916.5	-2.5	918.5	-0.5
35	919.0	-----	----	902.0	-17.0	910.5	-8.5
36	919.0	-----	----	-----	-----	-----	----
37	916.0	921.0	5.0	921.5	5.5	921.5	5.5
38	916.0	904.5	-11.5	912.0	-4.0	915.0	-1.0
39	916.0	897.0	-19.0	908.0	-8.0	911.0	-5.0
40	916.0	908.0	-8.0	914.0	-2.0	915.5	-0.5
41	920.5	-----	----	-----	-----	-----	----

NOTE: Pressures are recorded in prototype ft of water to the nearest half ft.
Locations of piezometers are shown on plate 19.

TABLE 4

MODEL STUDY OF SLUICES

FALL RIVER DAM

Pressures

Type 4 Design

Piezometer Number	Piezometer Zero	Discharge - 2670 cfs Pool Elev - 987.5		Discharge - 2080 cfs Pool Elev - 962.5		Discharge - 1660 cfs Pool Elev - 948.5	
		Piezometer Reading	Pressure	Piezometer Reading	Pressure	Piezometer Reading	Pressure
16	923.5	922.5	-1.0	924.5	1.0	922.5	-1.0
17	923.5	923.0	-0.5	922.0	-1.5	922.0	-1.5
18	920.5	923.0	2.5	923.0	2.5	922.5	2.0
19	917.5	923.0	5.5	923.0	5.5	922.5	5.0
20	915.0	922.0	7.0	922.0	7.0	922.5	7.5
21	923.5	922.0	-1.5	922.0	-1.5	922.5	-1.0
22	923.5	923.5	0.0	924.0	0.5	922.5	-1.0
23	920.5	920.5	0.0	921.5	1.0	921.5	1.0
24	917.5	920.0	2.5	920.5	3.0	921.0	3.5
25	915.0	920.0	5.0	920.5	5.5	921.0	6.0
26	922.5	923.0	0.5	922.5	0.0	922.5	0.0
27	922.5	921.5	-1.0	922.0	-0.5	922.0	-0.5
28	922.5	921.5	-1.0	922.5	0.0	922.0	-0.5
29	922.5	922.5	0.0	923.0	0.5	922.5	0.0
30	922.5	922.0	-0.5	922.0	-0.5	922.0	-0.5
31	919.0	912.0	-7.0	915.5	-3.5	918.0	-1.0
32	919.0	910.0	-9.0	913.5	-5.5	916.5	-2.5
33	919.0	911.0	-8.0	916.0	-3.0	918.0	-1.0
34	919.0	921.0	2.0	920.5	1.5	921.0	2.0
35	919.0	924.0	5.0	923.0	4.0	922.5	3.5
36	919.0	924.0	5.0	922.5	3.5	922.0	3.0
37	916.0	907.5	-8.5	912.5	-3.5	916.0	0.0
38	916.0	904.0	-12.0	910.5	-5.5	915.0	-1.0
39	916.0	910.5	-5.5	915.5	-0.5	917.5	1.5
40	916.0	919.0	3.0	920.0	4.0	920.5	4.5
41	916.0	922.5	6.5	922.0	6.0	921.5	5.5
42	916.0	921.0	5.0	920.0	4.0	920.0	4.0

NOTE: Pressures are recorded in prototype ft of water to the nearest half ft

Location of piezometers are shown on plate 37.

TABLE 5

MODEL STUDY OF SLUICES

FALL RIVER DAM

Pressures

Type 5 Design

Piezometer Number	Piezometer Zero	Discharge - 2670 cfs Pool Elev - 987.5		Discharge - 2080 cfs Pool Elev - 962.5		Discharge - 1660 cfs Pool Elev - 948.5	
		Piezometer Reading	Pressure	Piezometer Reading	Pressure	Piezometer Reading	Pressure
16	923.5	924.0	0.5	923.5	0.0	923.0	-0.5
17	923.5	924.0	0.5	923.5	0.0	923.0	-0.5
18	920.5	925.0	4.5	924.0	3.5	923.5	3.0
19	917.5	925.0	7.5	924.0	6.5	923.5	6.0
20	915.0	924.5	9.5	923.5	8.5	923.5	8.5
21	923.5	924.0	0.5	923.5	0.0	923.0	-0.5
22	923.5	924.0	0.5	923.5	0.0	923.0	-0.5
23	920.5	922.5	2.0	922.5	2.0	922.5	2.0
24	917.5	921.5	4.0	922.0	4.5	921.5	4.0
25	915.0	921.5	6.5	921.5	6.5	921.5	6.5
26	922.5	926.0	3.5	924.5	2.0	923.5	1.0
27	922.5	925.5	3.0	924.5	2.0	923.5	1.0
28	922.5	924.0	1.5	923.5	1.0	923.0	0.5
29	922.5	923.0	0.5	923.0	0.5	923.0	0.5
30	922.5	923.5	1.0	923.5	1.0	923.5	1.0
31	919.0	913.5	-5.5	916.5	-2.5	918.5	-0.5
32	919.0	911.0	-8.0	915.0	-4.0	917.5	-1.5
33	919.0	914.0	-5.0	916.5	-2.5	918.5	-0.5
34	919.0	921.5	2.5	921.5	2.5	921.5	2.5
35	919.0	924.5	5.5	923.5	4.5	922.5	3.5
36	919.0	924.0	5.0	923.0	4.0	922.0	3.0
37	916.0	908.0	-8.0	914.5	-1.5	916.5	0.5
38	916.0	904.0	-12.0	910.5	-5.5	915.5	-0.5
39	916.0	911.5	-4.5	915.5	-0.5	918.0	2.0
40	916.0	921.0	5.0	921.0	5.0	921.5	5.5
41	916.0	924.0	8.0	923.0	7.0	922.0	6.0
42	916.0	921.5	5.5	920.5	4.5	920.0	4.0

NOTE: Pressures are recorded in prototype ft of water to the nearest half ft.
Locations of piezometers are shown on plate 37.

TABLE 6

MODEL STUDY OF SLUICES

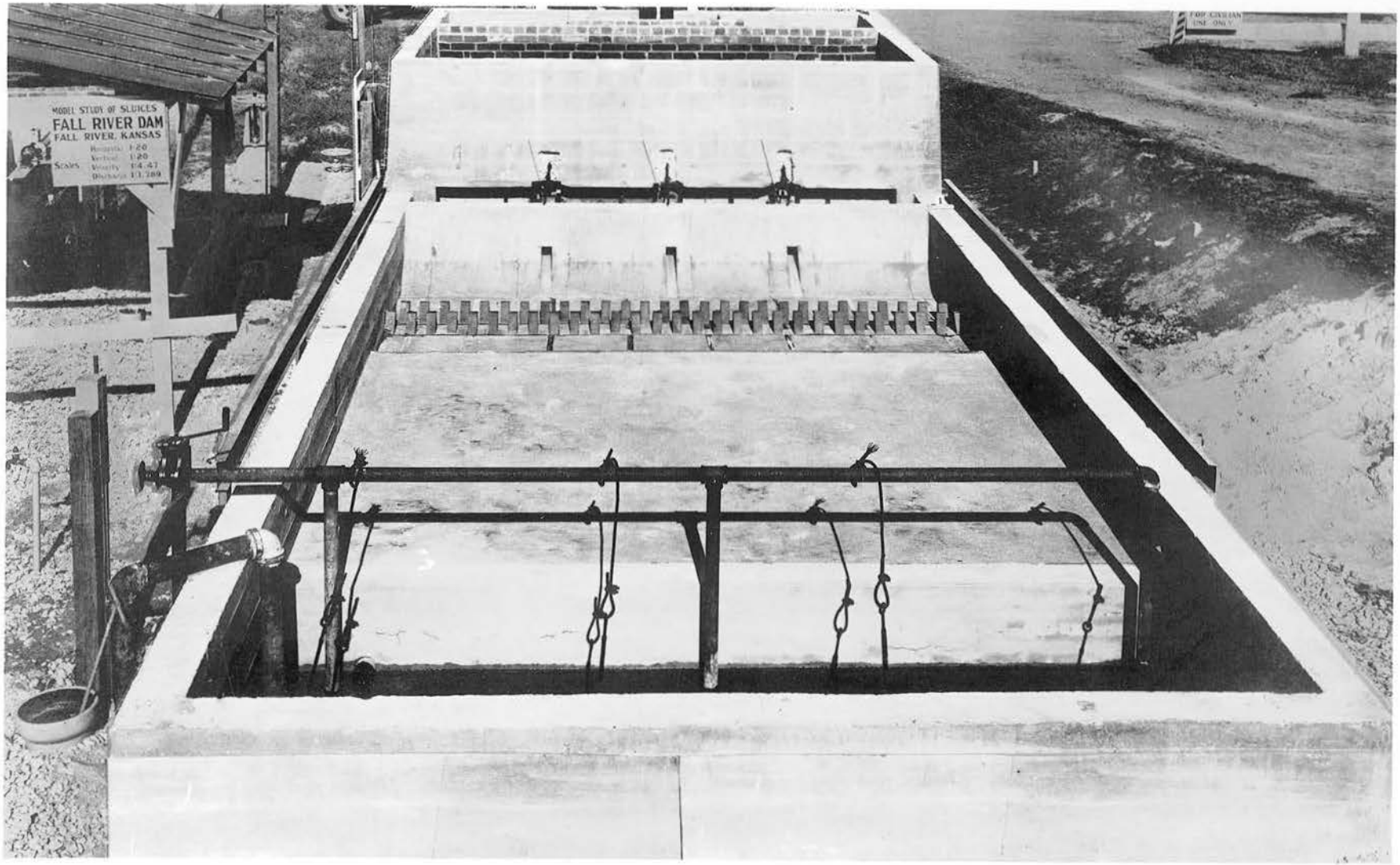
FALL RIVER DAM

Pressures

Type 6 Design (Final Design)

Piezometer Number	Piezometer Zero	Discharge - 2520 cfs Pool Elev - 987.5		Discharge - 1990 cfs Pool Elev - 962.5		Discharge - 1610 cfs Pool Elev - 948.5	
		Piezometer Reading	Pressure	Piezometer Reading	Pressure	Piezometer Reading	Pressure
16	923.5	929.0	5.5	926.5	3.0	925.0	1.5
17	923.5	929.0	5.5	926.5	3.0	924.5	1.0
18	920.5	930.0	9.5	927.0	6.5	925.0	4.5
19	917.5	930.0	12.5	927.0	9.5	925.0	7.5
20	915.0	929.5	14.5	926.5	11.5	925.0	10.0
21	923.5	929.0	5.5	926.0	2.5	924.5	1.0
22	923.5	928.5	5.0	926.0	2.5	924.5	1.0
23	920.5	927.0	6.5	925.0	4.5	924.0	3.5
24	917.5	927.0	9.5	925.0	7.5	923.5	6.0
25	915.0	926.5	11.5	924.5	9.5	923.5	8.5
26	922.5	929.5	7.0	926.5	4.0	925.0	2.5
27	922.5	928.5	6.0	926.0	3.5	925.0	2.5
28	922.5	926.0	3.5	924.5	2.0	923.5	1.0
29	922.5	924.0	1.5	923.5	1.0	923.0	0.5
30	922.5	923.5	1.0	923.5	1.0	923.0	0.5
31	919.0	918.5	-0.5	919.5	0.5	920.0	1.0
32	919.0	915.5	-3.5	917.5	-1.5	919.0	0.0
33	919.0	917.5	-1.5	918.5	-0.5	919.5	0.5
34	919.0	924.0	5.0	922.5	3.5	922.0	3.0
35	919.0	926.0	7.0	924.0	5.0	923.0	4.0
36	919.0	924.0	5.0	922.5	3.5	921.5	2.5
37	916.0	916.0	0.0	917.5	1.5	919.0	3.0
38	916.0	911.0	-5.0	915.0	-1.0	917.0	1.0
39	916.0	915.5	-0.5	917.5	1.5	919.0	3.0
40	916.0	922.5	6.5	922.0	6.0	921.5	5.5
41	916.0	924.5	8.5	923.0	7.0	922.5	6.5
42	916.0	920.5	4.5	920.0	4.0	919.0	3.0

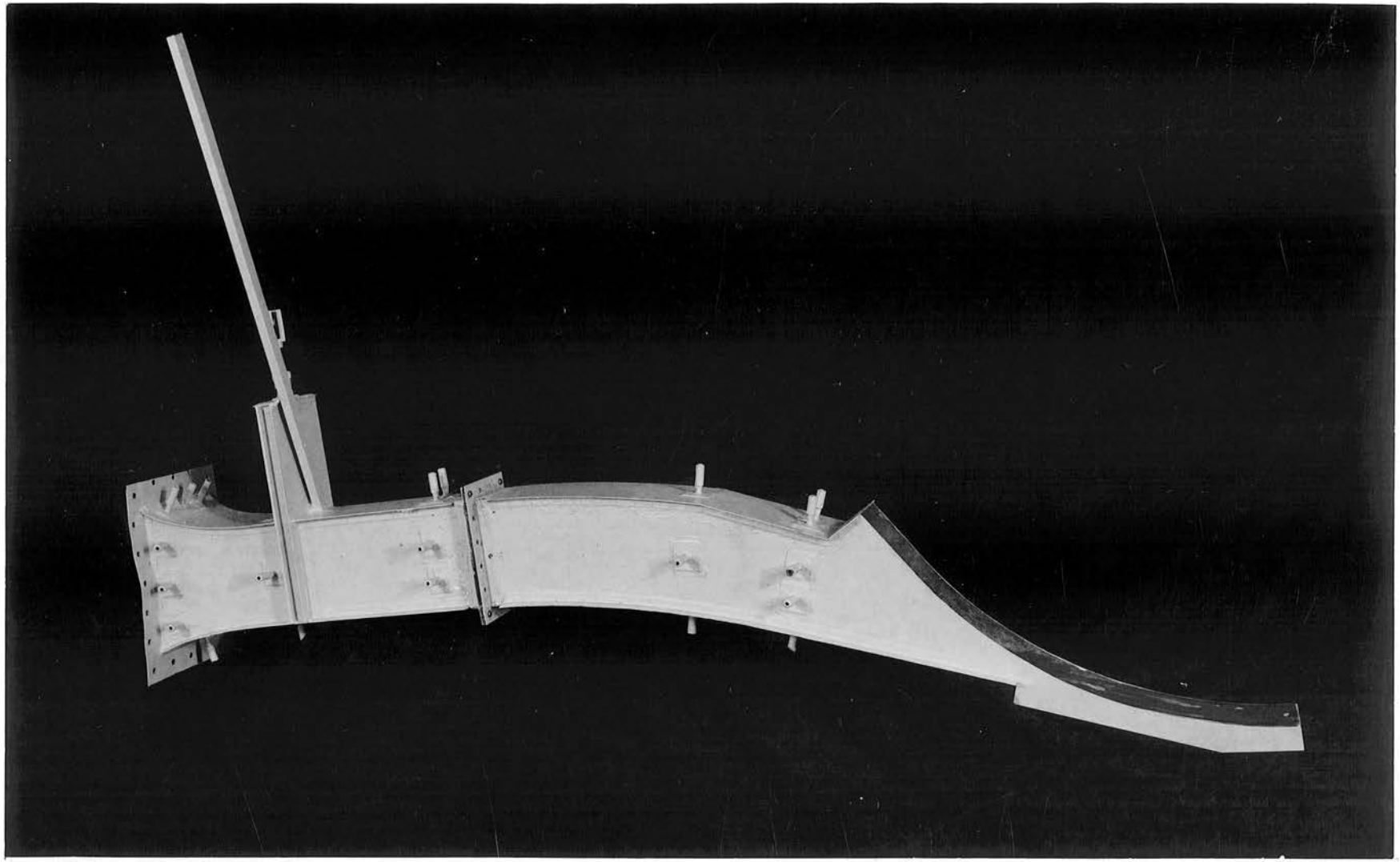
NOTE: Pressures are recorded in prototype ft of water to the nearest half ft.
Locations of piezometers are shown on plate 37.



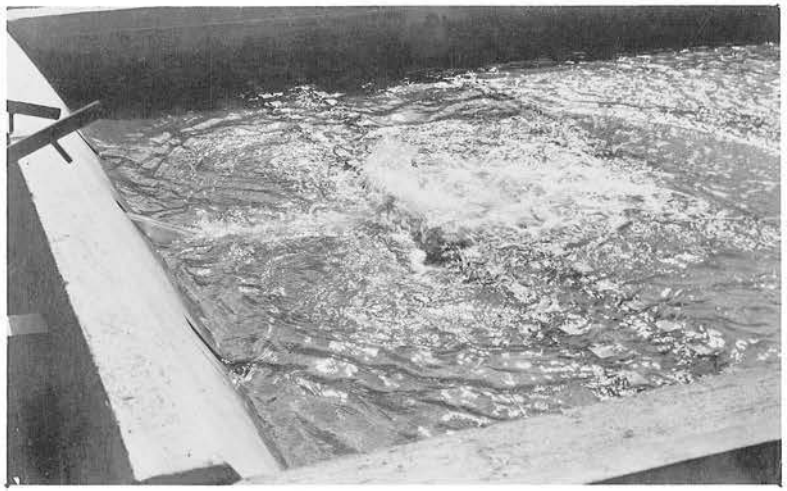
PHOTOGRAPH 1

Fall River model looking upstream

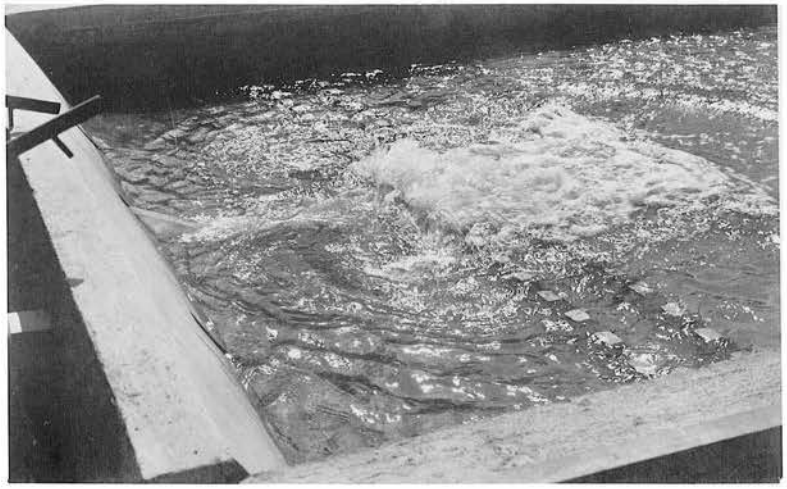
PHOTOGRAPH 2



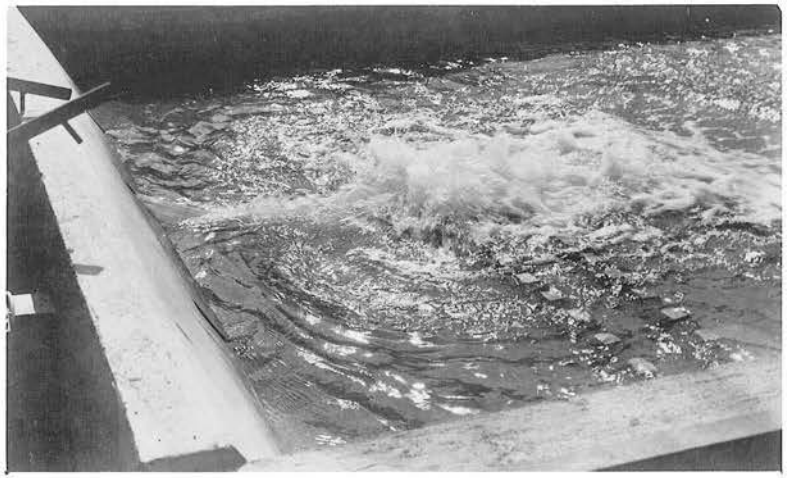
Type-1 design sluice



a. Discharge 1640 cfs
Pool elev 950.0 Tailwater elev 911.6



b. Discharge 1900 cfs
Pool elev 962.5 Tailwater elev 912.0

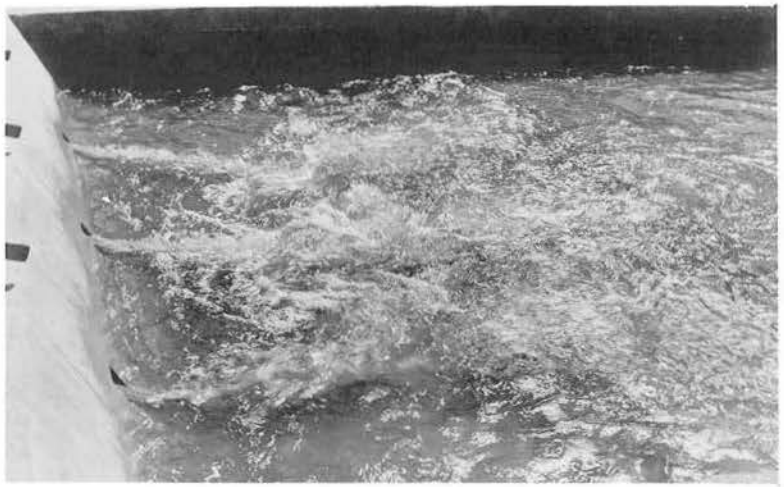


c. Discharge 2400 cfs
Pool elev 987.5 Tailwater elev 912.8

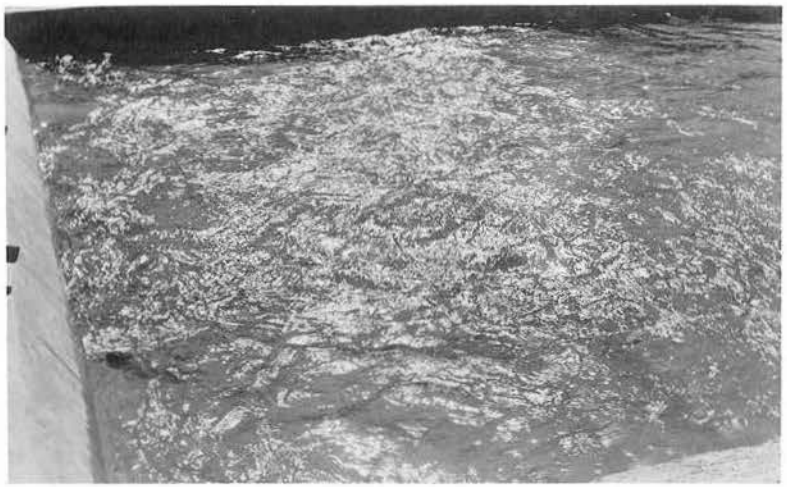
Flow conditions for
type-1 sluice and type-1 stilling basin

PHOTOGRAPH 3

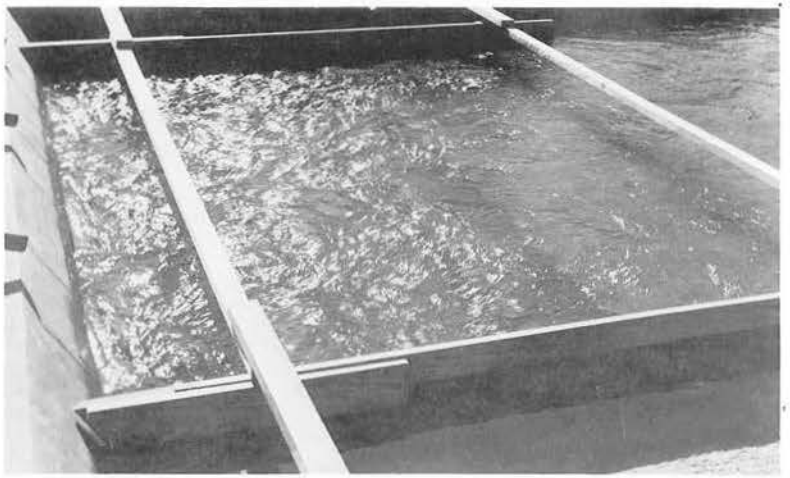
PHOTOGRAPH 4



a. Discharge 5,630 cfs
Pool elev 962.5 Tailwater elev 916.8

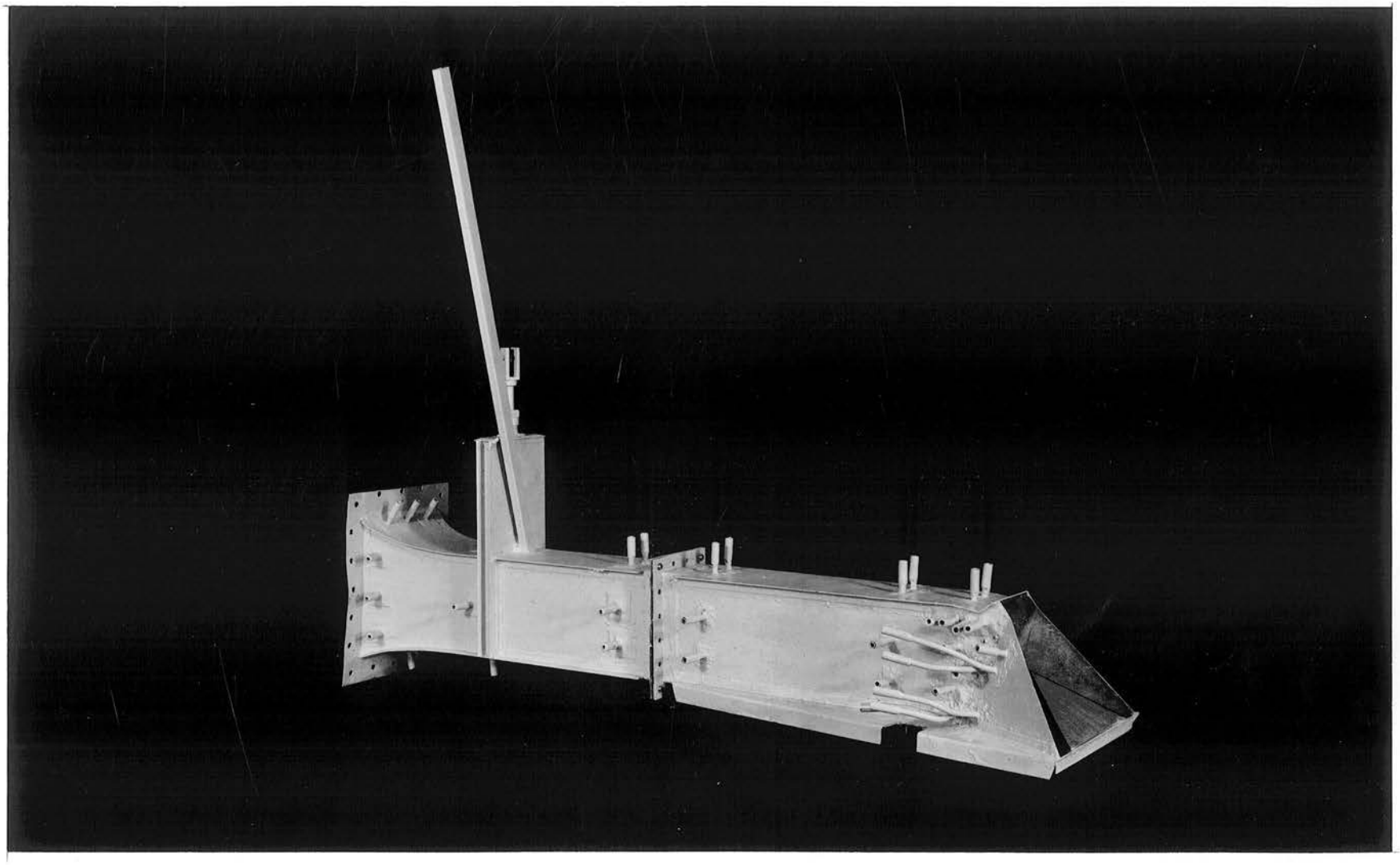


b. Discharge 15,633 cfs
Pool elev 987.5 Tailwater elev 925.2



c. Discharge 15,633 cfs
Pool elev 987.5 Tailwater elev 925.2

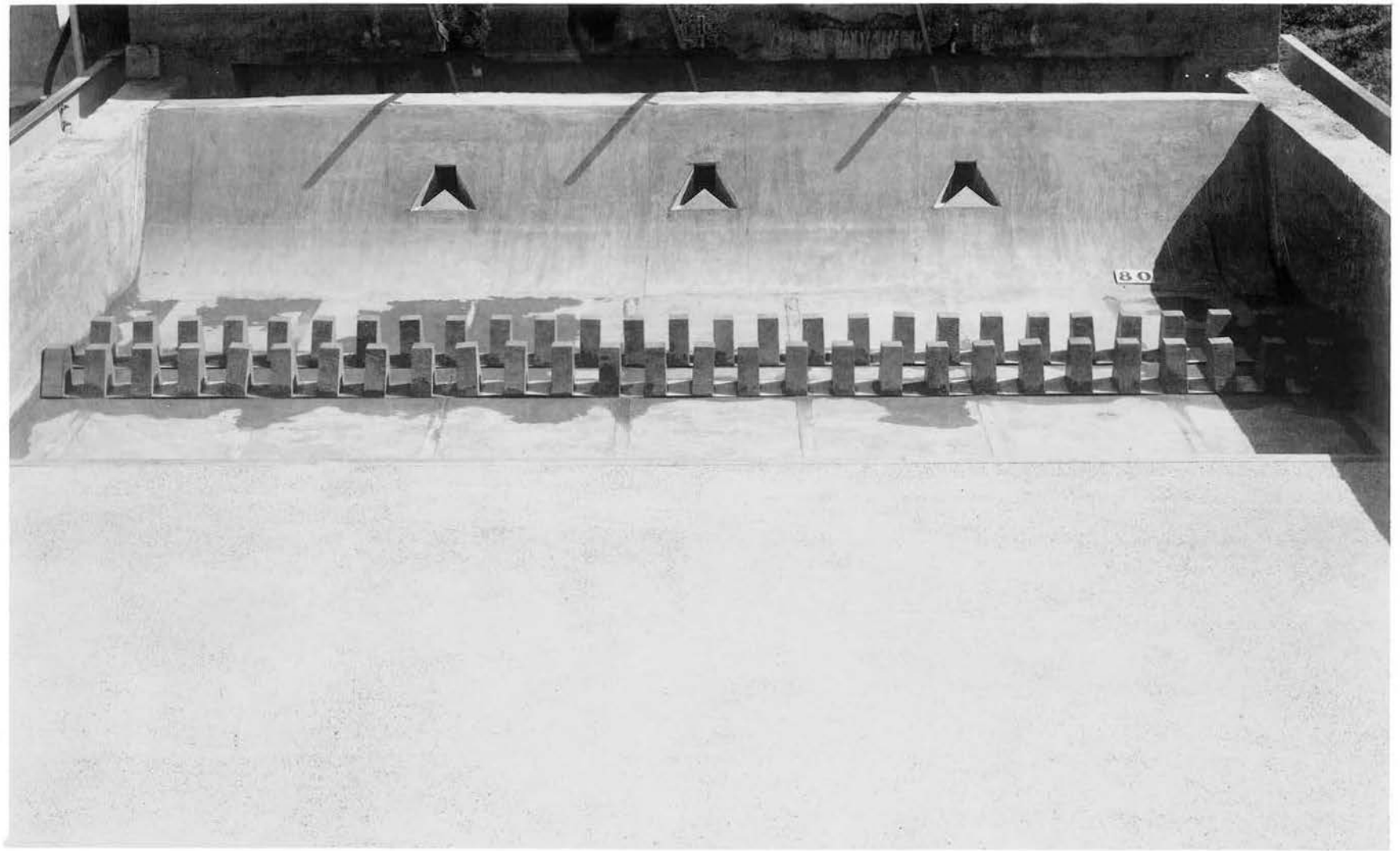
Flow conditions for
type-1 sluices and type-1 stilling basin



PHOTOGRAPH 5

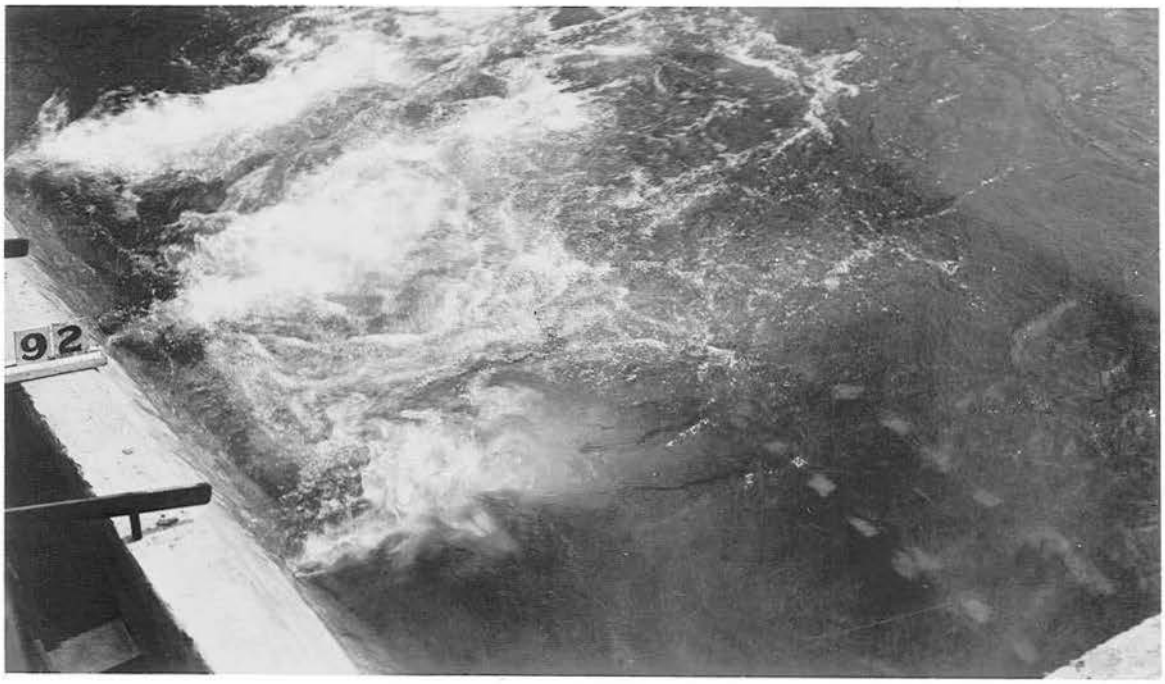
Type-2 design sluice

PHOTOGRAPH 6



Type-1 stilling basin with type-2 sluices installed

a. Discharge 2,500 cfs
Pool elev 987.5 Tailwater elev 913.3

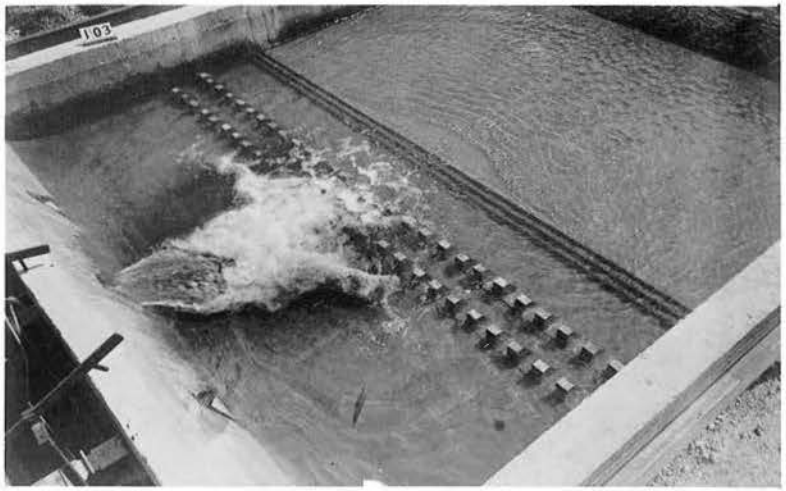


b. Discharge 17,966
Pool elev 987.5 Tailwater elev 925.8

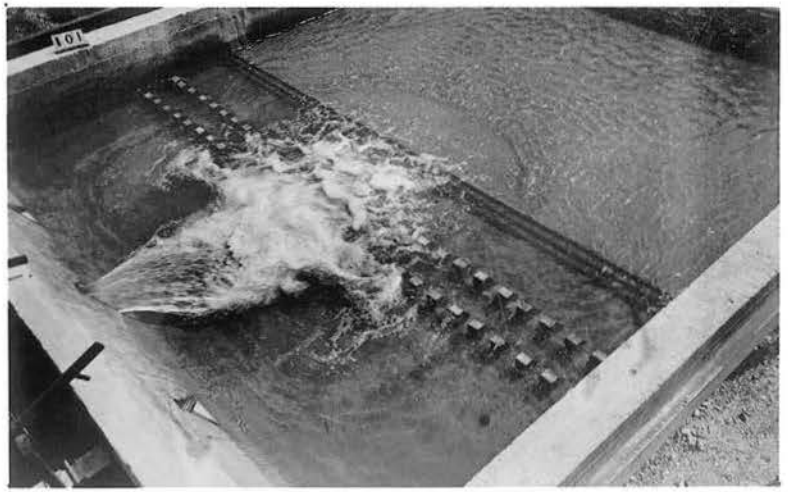
Flow conditions for
type-2 sluices and type-1 stilling basin

PHOTOGRAPH 7

PHOTOGRAPH 8



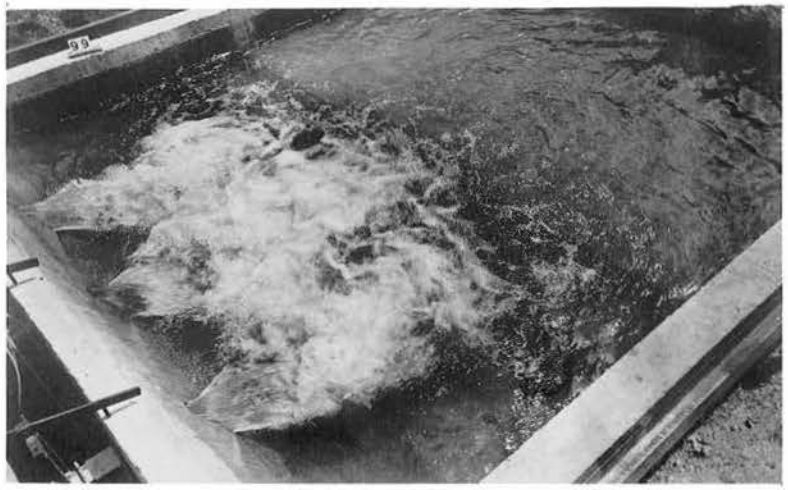
a. Discharge 1640 cfs
Pool elev 948.5 Tailwater elev 911.6



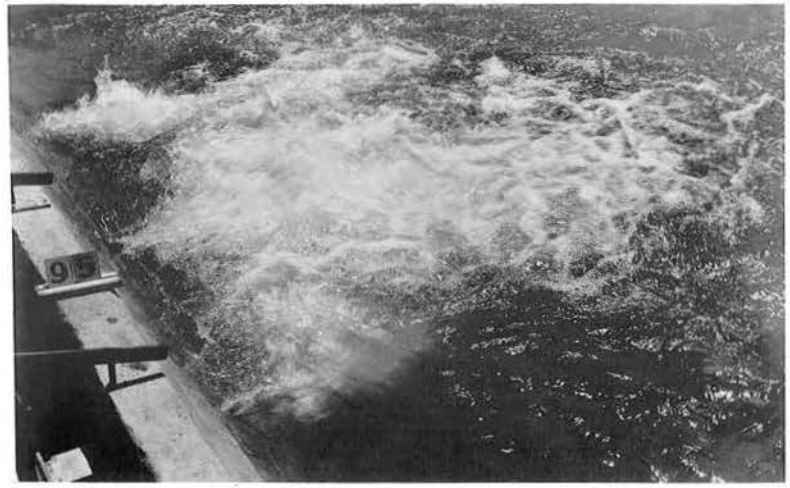
b. Discharge 2040 cfs
Pool elev 962.5 Tailwater elev 912.3

c. Discharge 2520 cfs
Pool elev 987.5 Tailwater elev 913.3

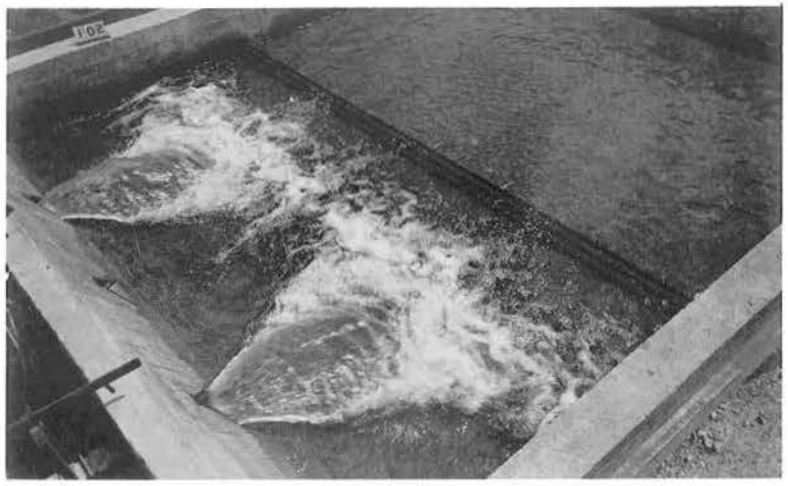
Flow conditions for
type-2 sluice and type-2 stilling basin



a. Discharge 6,075 cfs
Pool elev 962.5 Tailwater elev 917.3



b. Discharge 17,966 cfs
Pool elev 987.5 Tailwater elev 925.8

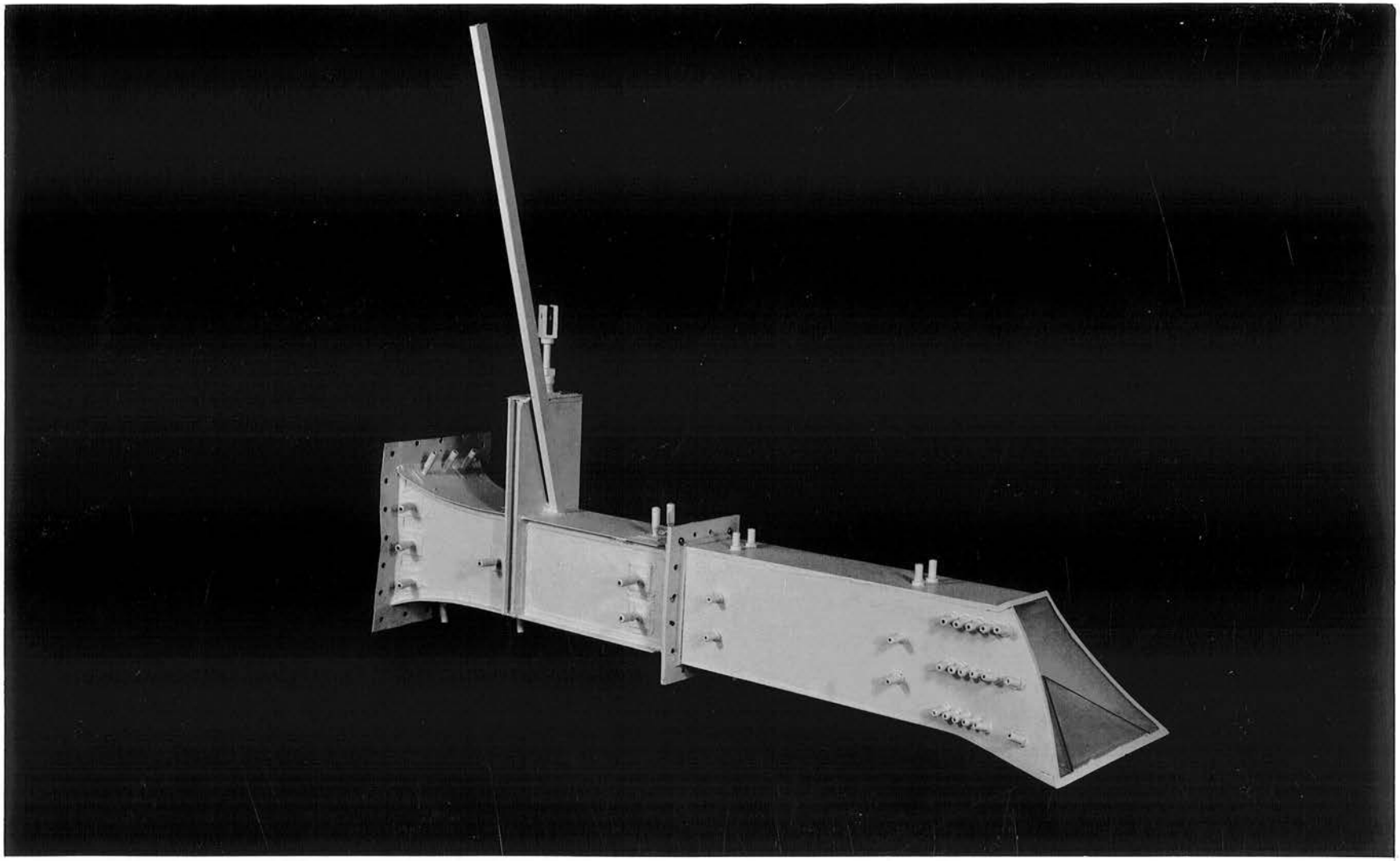


c. Discharge 2,040 cfs
Pool elev 962.5 Tailwater elev 912.3

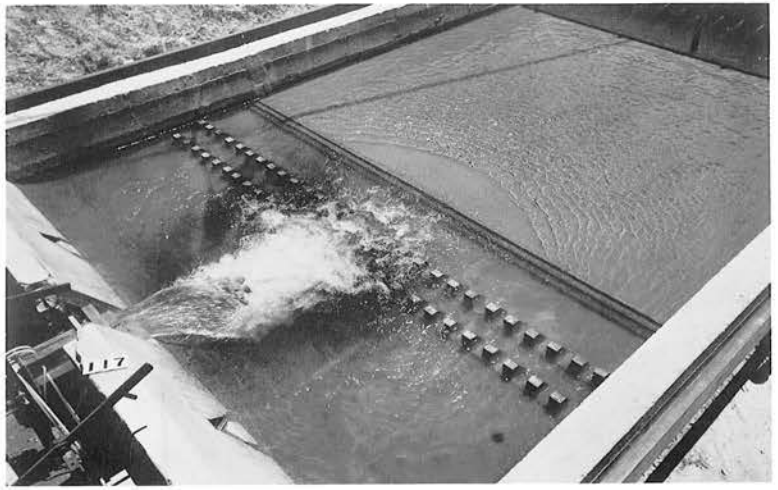
Flow conditions for
type-2 sluices and type-2 stilling basin

PHOTOGRAPH 9

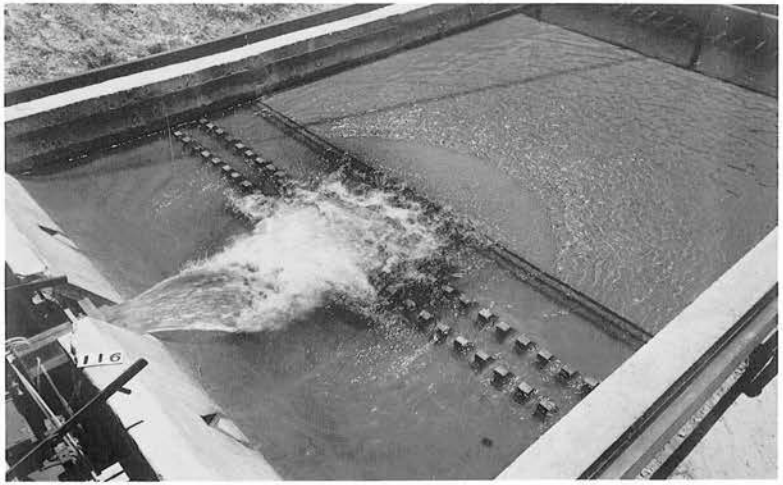
PHOTOGRAPH 10



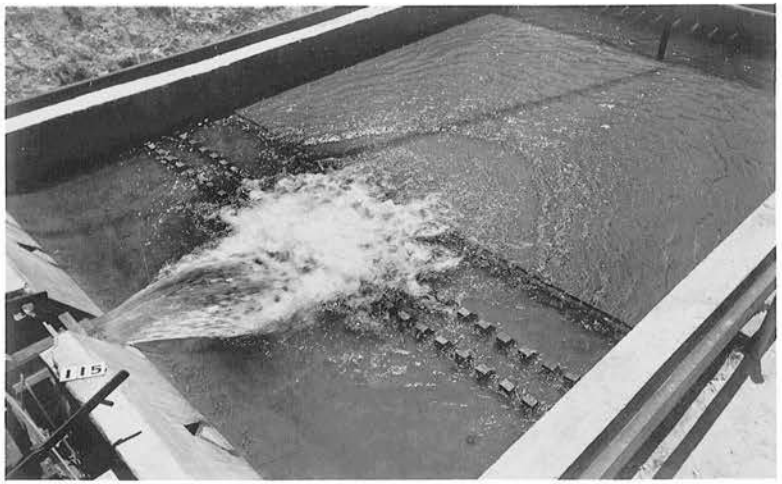
Type-6 design sluice



a. Discharge 1610 cfs
Pool elev 948.5 Tailwater elev 911.5



b. Discharge 1990 cfs
Pool elev 962.5 Tailwater elev 912.2



c. Discharge 2520 cfs
Pool elev 987.5 Tailwater elev 912.8

Flow conditions for
type-6 sluice and type-2 stilling basin

PHOTOGRAPH 11

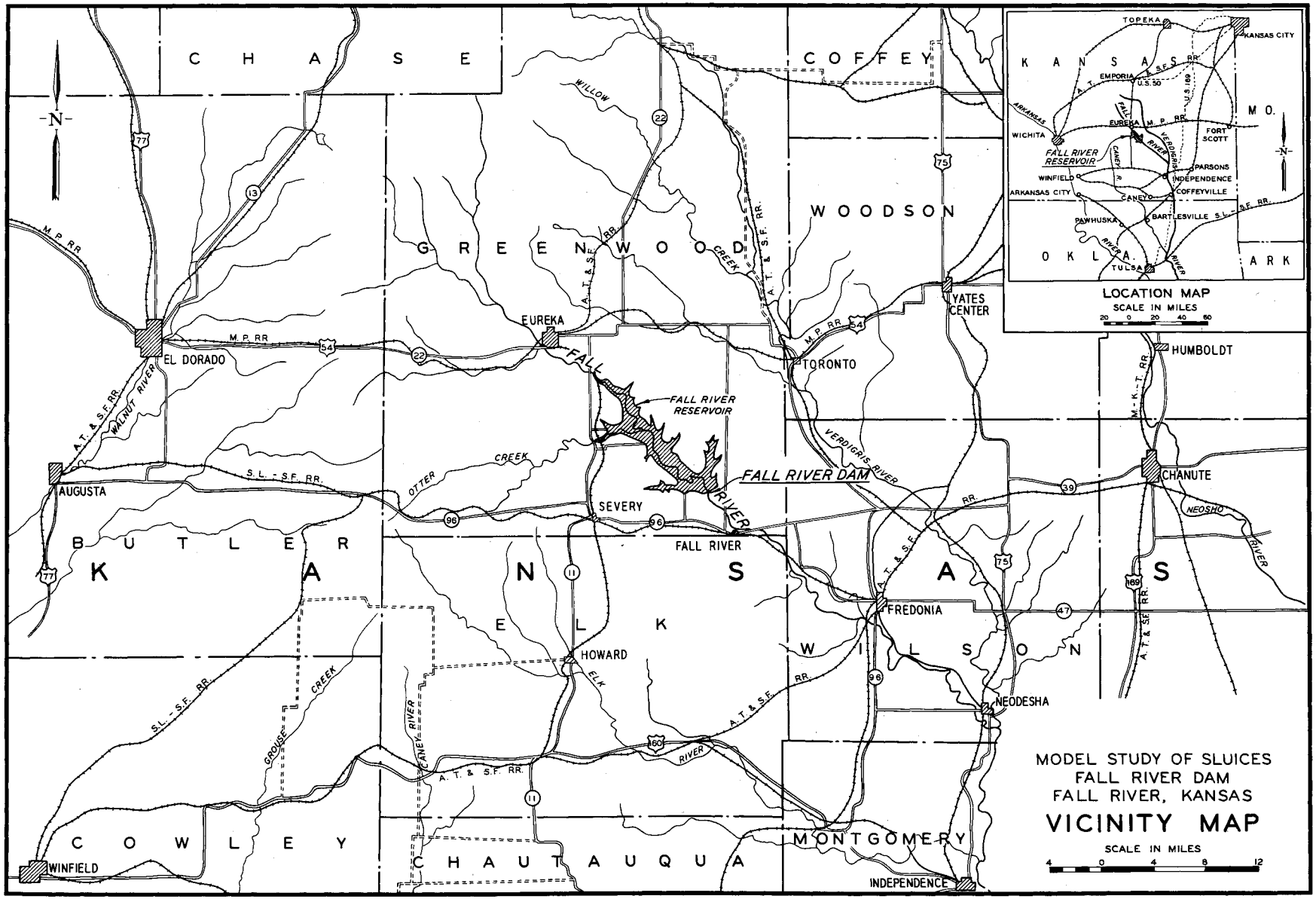
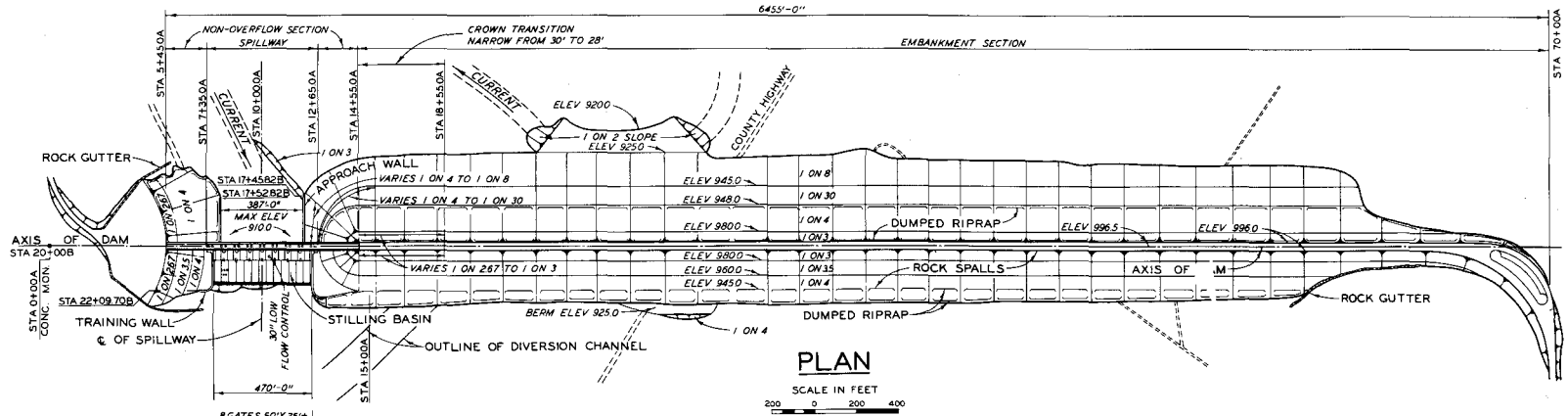
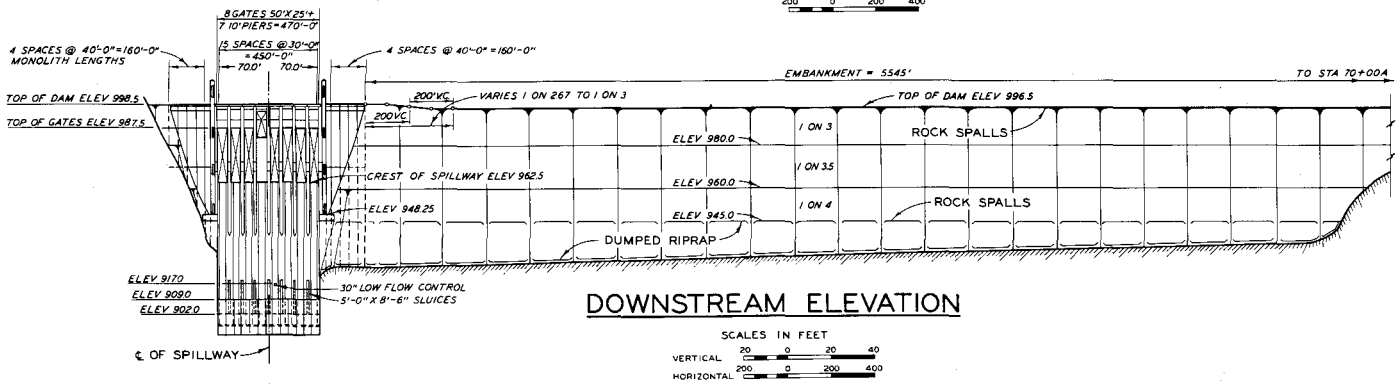

CHASE
COFFEY
WOODSON
GREENWOOD
BUTLER
KANSAS
ELK
WILSON
COWLEY
CHAUTAUQUA
MONTGOMERY
WILLOW CREEK
WALNUT RIVER
OTTER CREEK
GROUSE CREEK
CANEY RIVER
VERDIGRIS RIVER
NEOSHO RIVER
ELK RIVER
FALL RIVER
FALL RIVER RESERVOIR
FALL RIVER DAM
EL DORADO
AUGUSTA
EUREKA
SEVERY
FALL RIVER
HOWARD
TORONTO
YATES CENTER
HUMBOLDT
CHANUTE
FREDONIA
NEODESHA
INDEPENDENCE
WINFIELD
A.T.&S.F. RR.
M.P. RR
S.L.-S.F. RR
M.K.T. RR
LOCATION MAP
SCALE IN MILES
20 0 20 40 60
TOPEKA
KANSAS CITY
EMPORIA
WICHITA
FORT SCOTT
PARSONS
INDEPENDENCE
COFFEYVILLE
BARTLESVILLE
TULSA
ARKANSAS CITY
PAWHUSKA
MO.
OKLA.
ARK.
MODEL STUDY OF SLUICES
FALL RIVER DAM
FALL RIVER, KANSAS
VICINITY MAP
SCALE IN MILES
4 0 4 8 12

PLATE 1



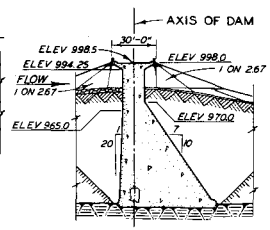
PLAN

SCALE IN FEET
200 0 200 400



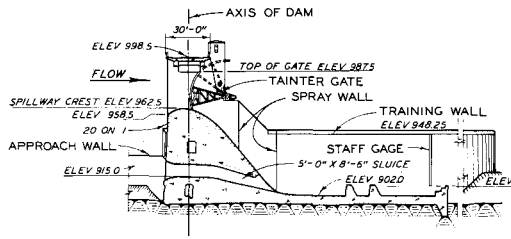
DOWNSTREAM ELEVATION

SCALES IN FEET
VERTICAL 20 0 20 40
HORIZONTAL 200 0 200 400



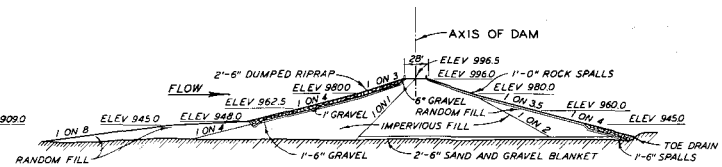
NON-OVERFLOW SECTION

SCALE IN FEET
30 0 30 60



SPILLWAY SECTION

SCALE IN FEET
30 0 30 60



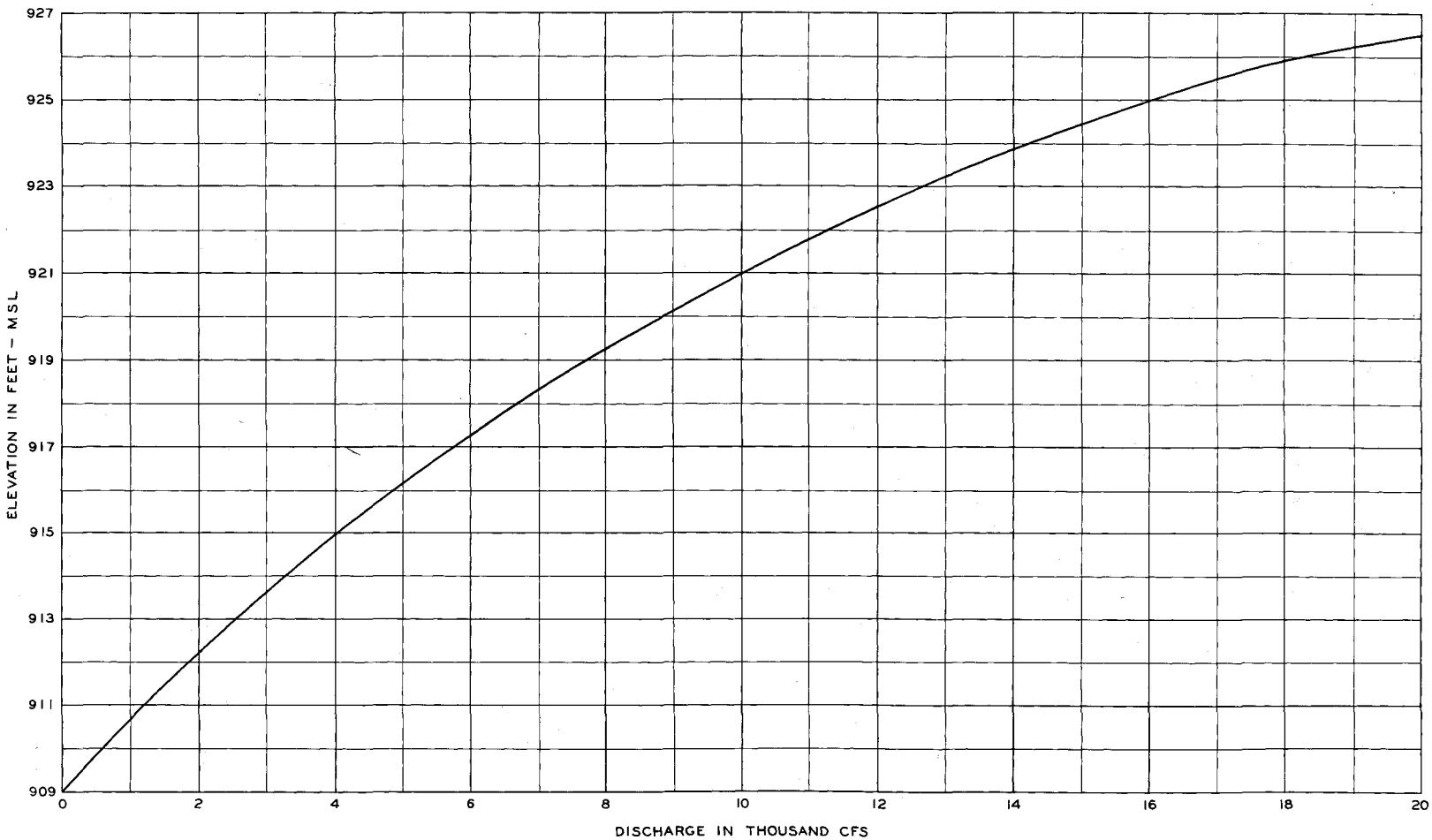
EMBANKMENT SECTION

SCALE IN FEET
50 0 50 100

MODEL STUDY OF SLUICES
FALL RIVER DAM
FALL RIVER, KANSAS

PLAN, ELEVATION AND SECTIONS

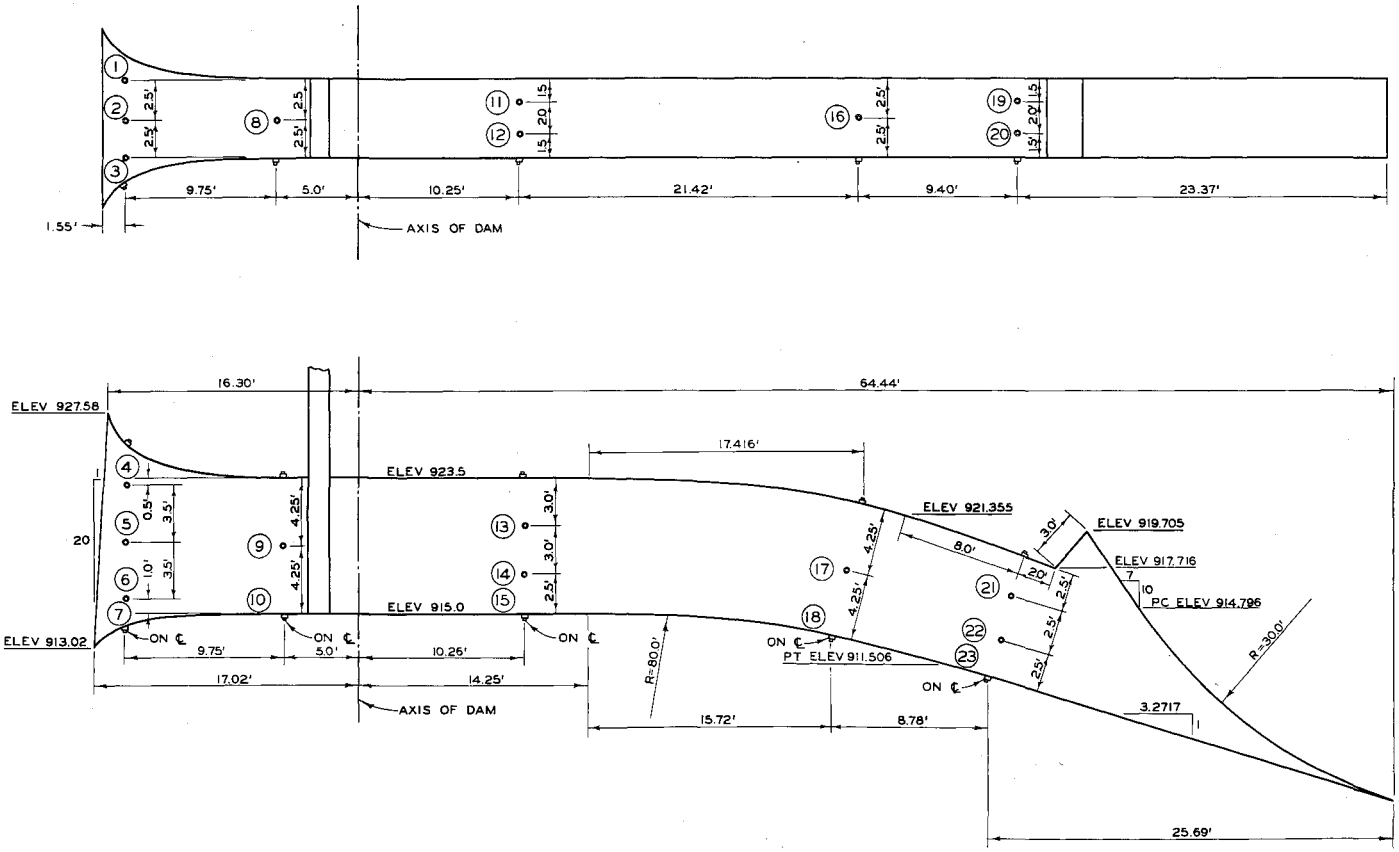
PLATE 2



MODEL STUDY OF SLUICES
FALL RIVER DAM
FALL RIVER, KANSAS

TAILWATER RATING CURVE

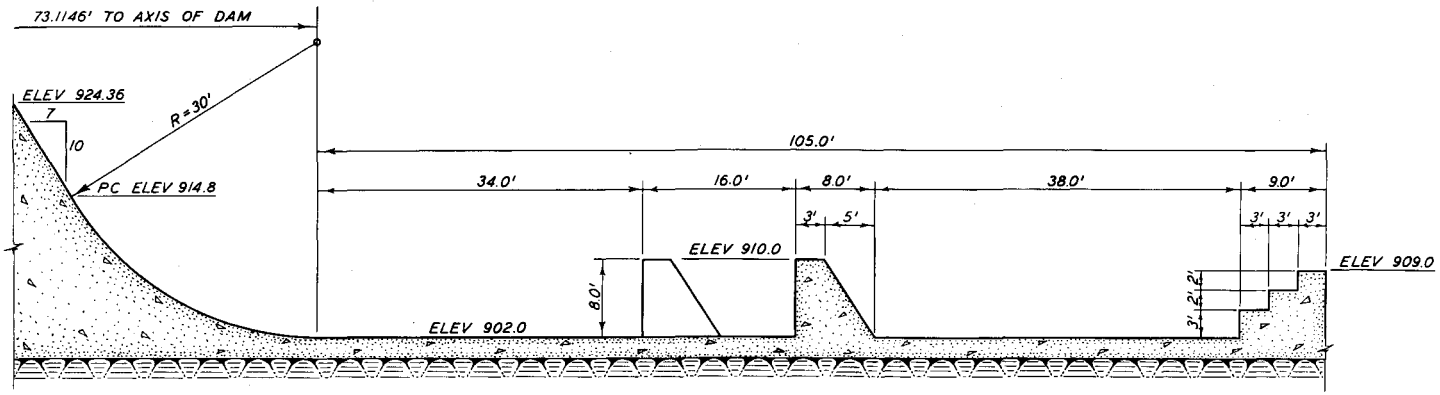
PLATE 3



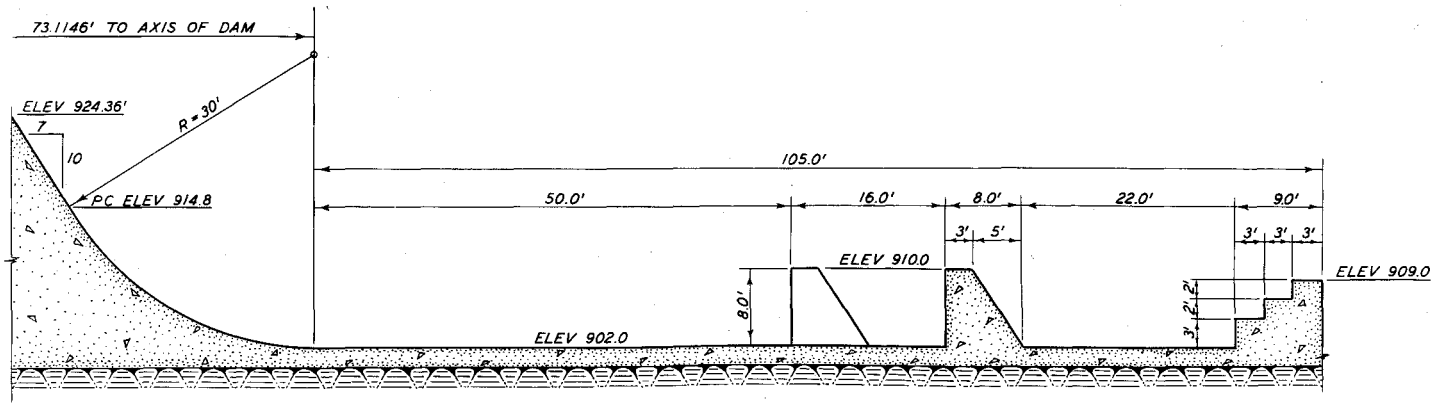
MODEL STUDY OF SLUICES
FALL RIVER DAM
FALL RIVER, KANSAS

TYPE I DESIGN

PLATE 4



TYPE 1 BASIN

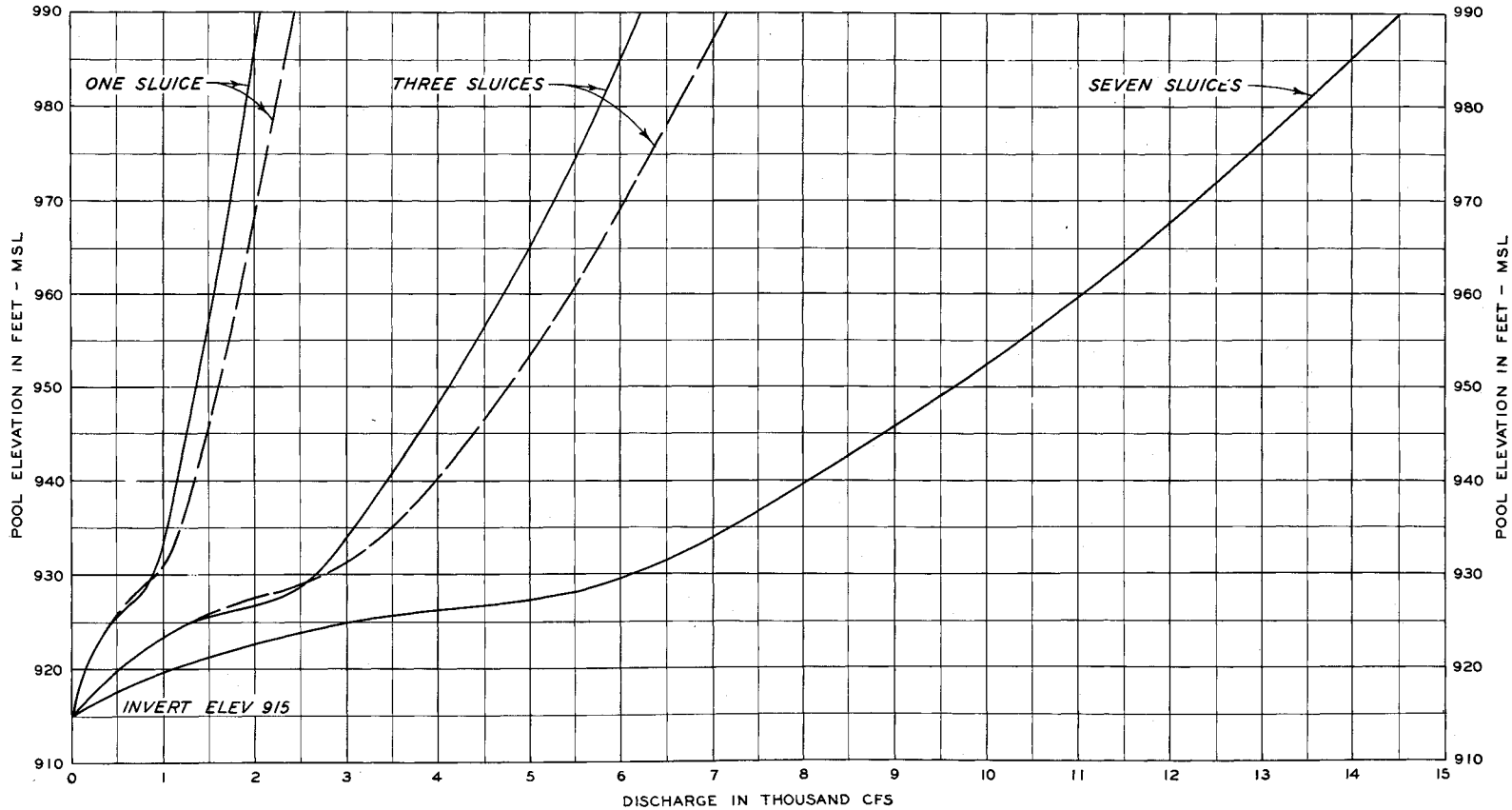


TYPE 2 BASIN

MODEL STUDY OF SLUICES
FALL RIVER DAM
FALL RIVER, KANSAS

ALTERNATE BASIN DESIGNS

PLATE 5



LEGEND

COMPUTED

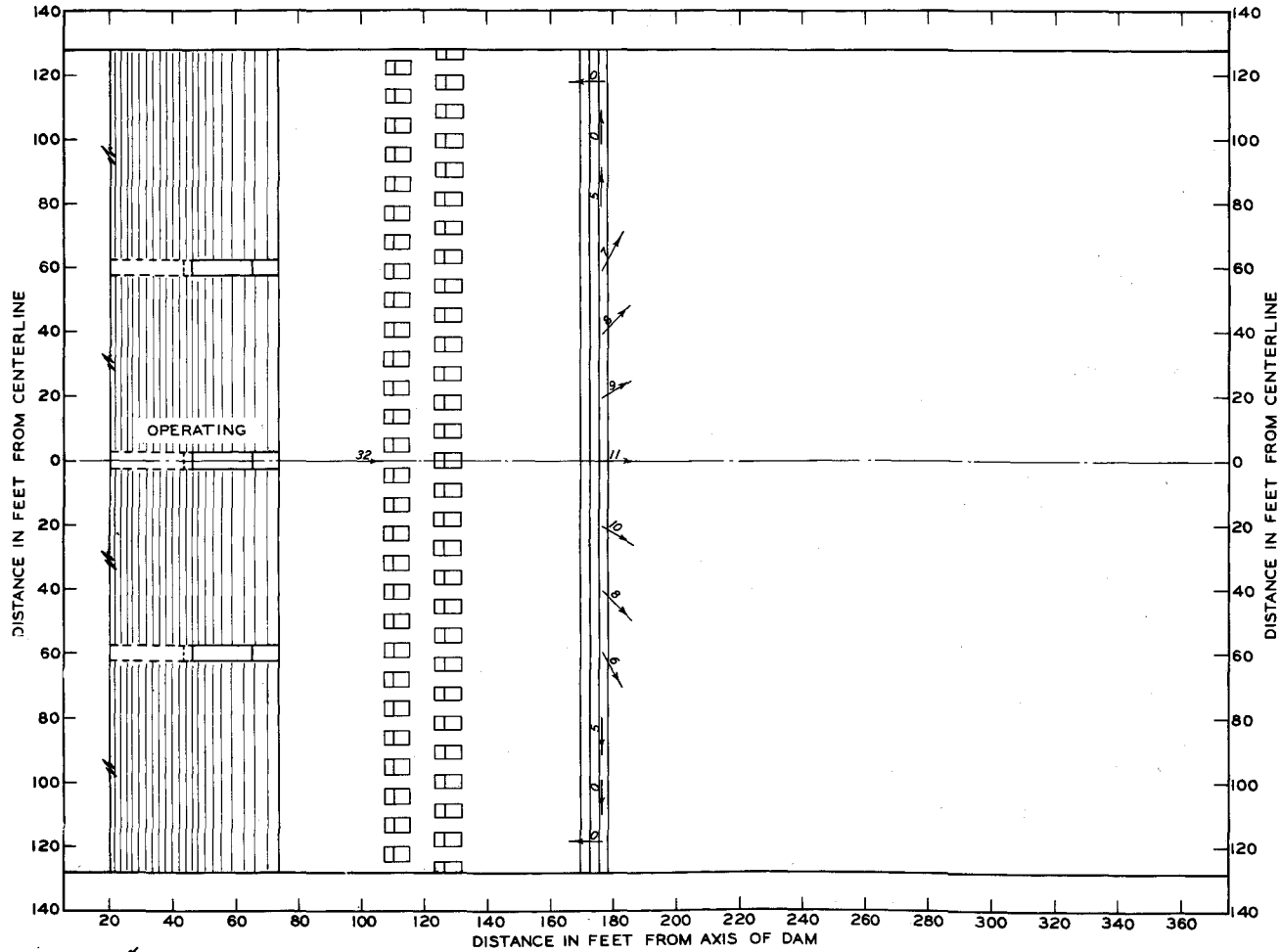
MODEL

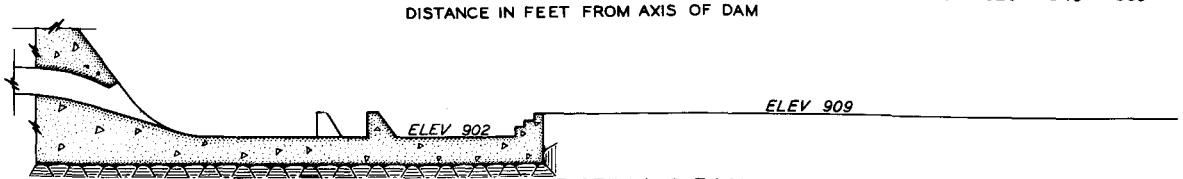
MODEL STUDY OF SLUICES
FALL RIVER DAM
FALL RIVER, KANSAS

SLUICE RATING CURVES

TYPE I DESIGN

PLATE 6





SECTION THROUGH CENTERLINE STILLING BASIN

TEST CONDITIONS

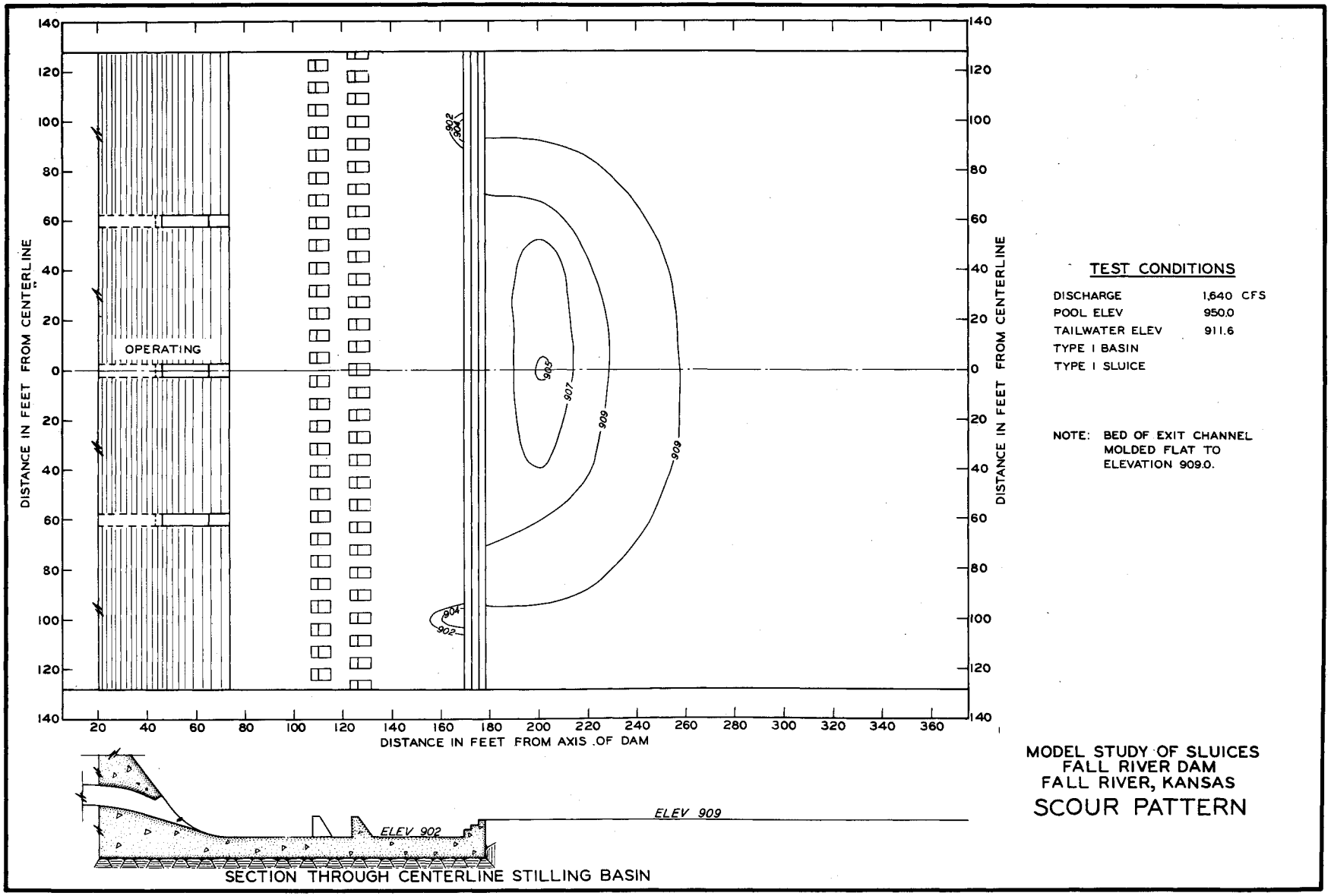
DISCHARGE	1,640 CFS
POOL ELEV	950.0
TAILWATER ELEV	911.6
TYPE I BASIN	
TYPE I SLUICE	

NOTE: BED OF EXIT CHANNEL FIXED IN CEMENT MORTAR AT ELEVATION 909.0.

MODEL STUDY OF SLUICES
FALL RIVER DAM
FALL RIVER, KANSAS

BOTTOM VELOCITIES

PLATE 7



TEST CONDITIONS

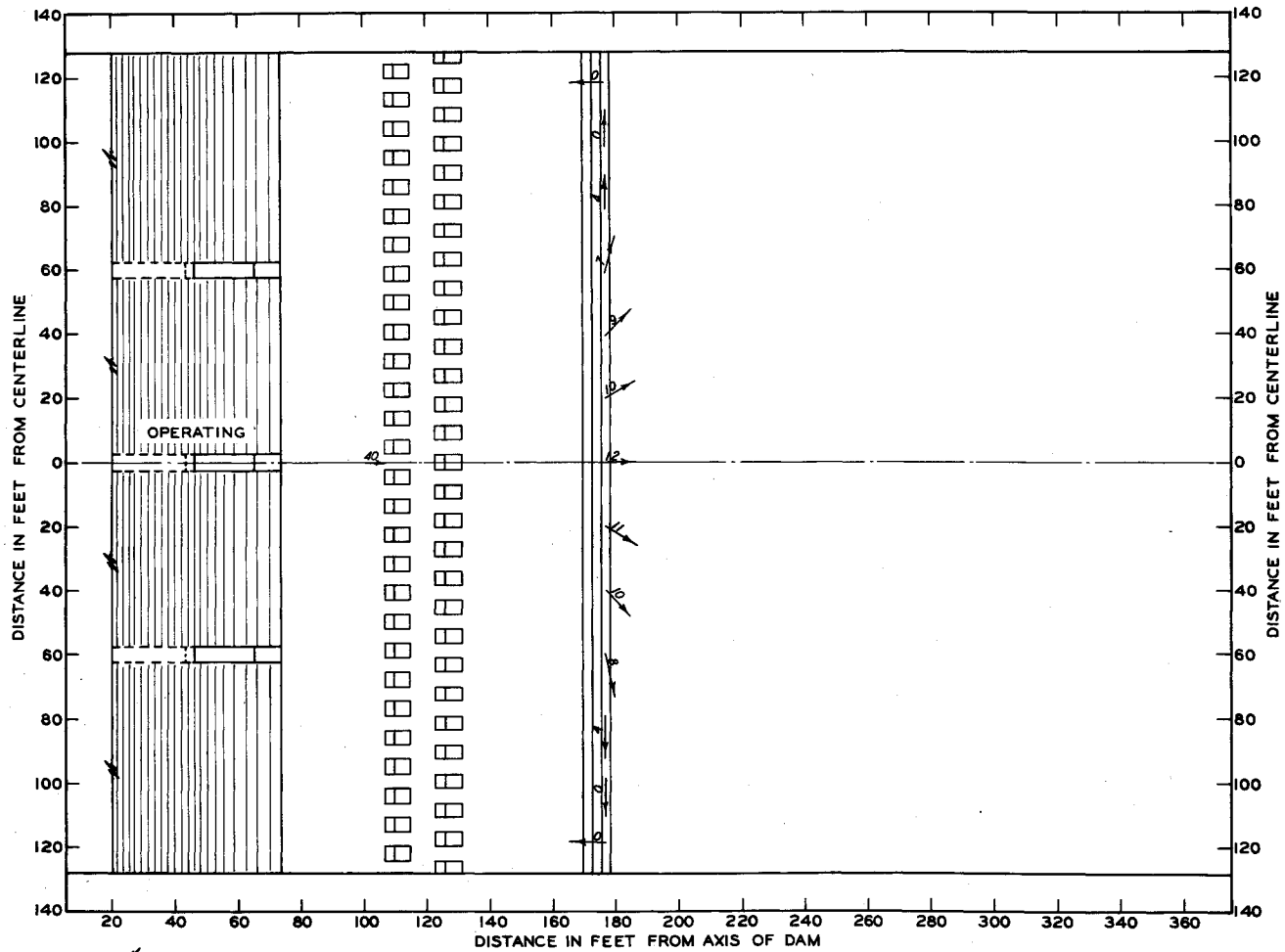
DISCHARGE	1,640 CFS
POOL ELEV	950.0
TAILWATER ELEV	911.6
TYPE I BASIN	
TYPE I SLUICE	

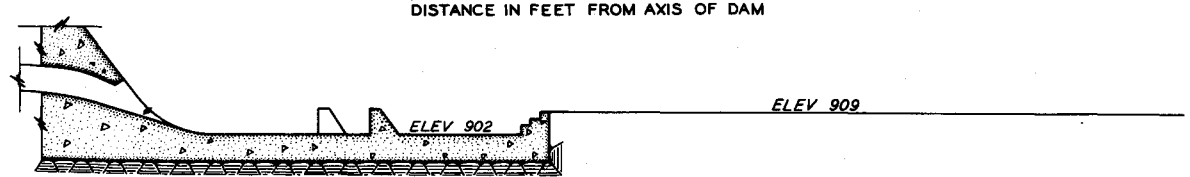
NOTE: BED OF EXIT CHANNEL MOLDED FLAT TO ELEVATION 909.0.

MODEL STUDY OF SLUICES
FALL RIVER DAM
FALL RIVER, KANSAS

SCOUR PATTERN

PLATE 8





SECTION THROUGH CENTERLINE STILLING BASIN

TEST CONDITIONS

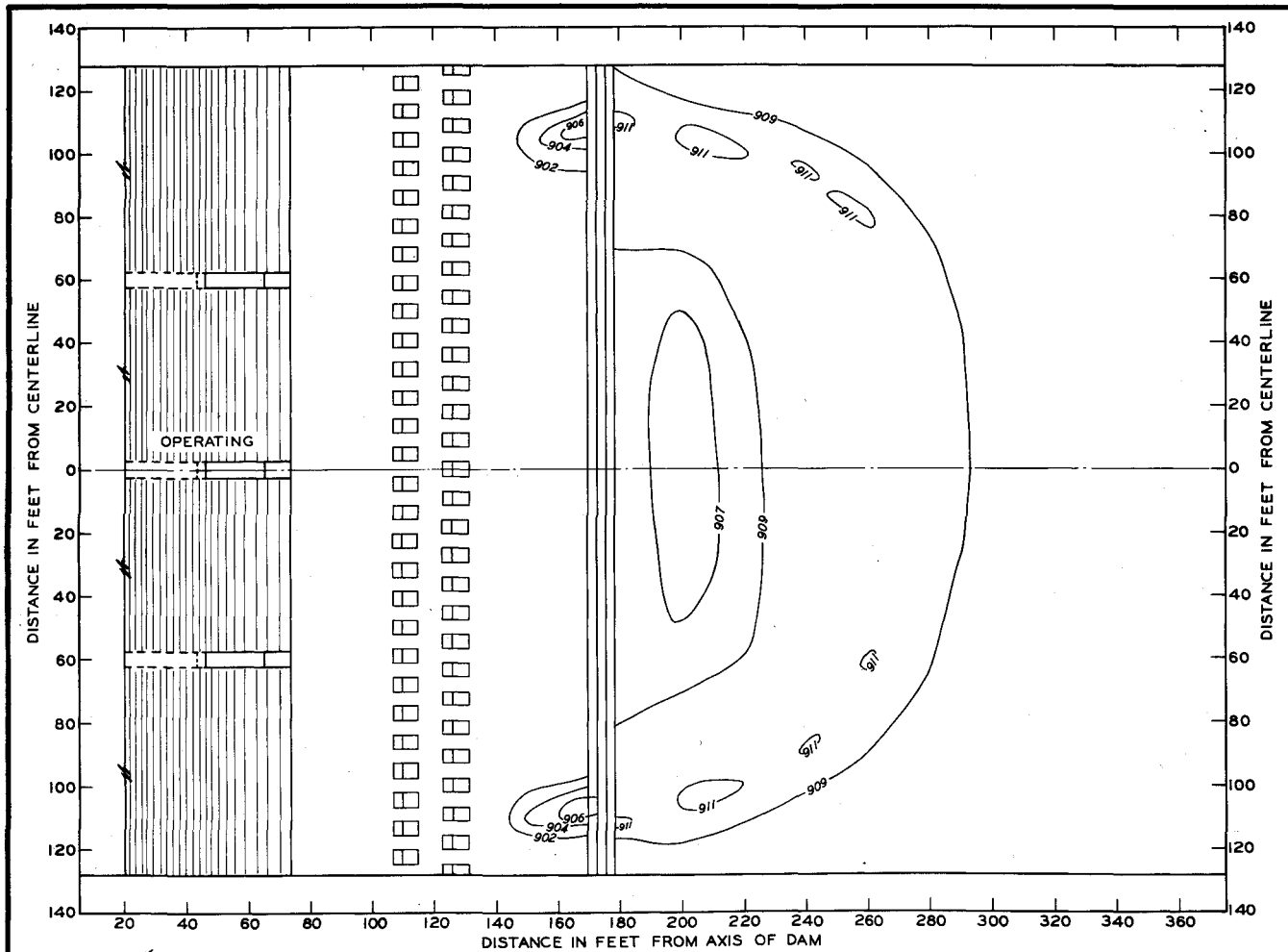
DISCHARGE	1,900 CFS
POOL ELEV	962.5
TAILWATER ELEV	912.0
TYPE I BASIN	
TYPE I SLUICE	

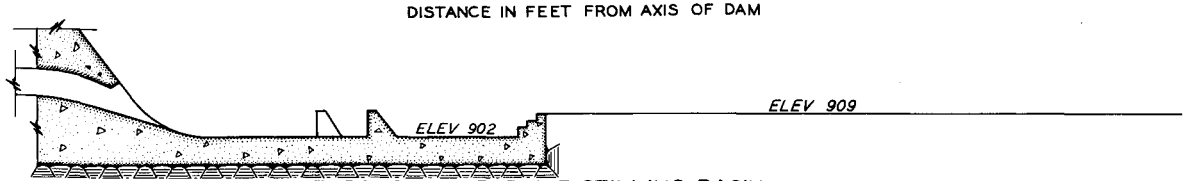
NOTE: BED OF EXIT CHANNEL FIXED IN CEMENT MORTAR AT ELEVATION 909.0

MODEL STUDY OF SLUICES
FALL RIVER DAM
FALL RIVER, KANSAS

BOTTOM VELOCITIES

PLATE 9





SECTION THROUGH CENTERLINE STILLING BASIN

TEST CONDITIONS

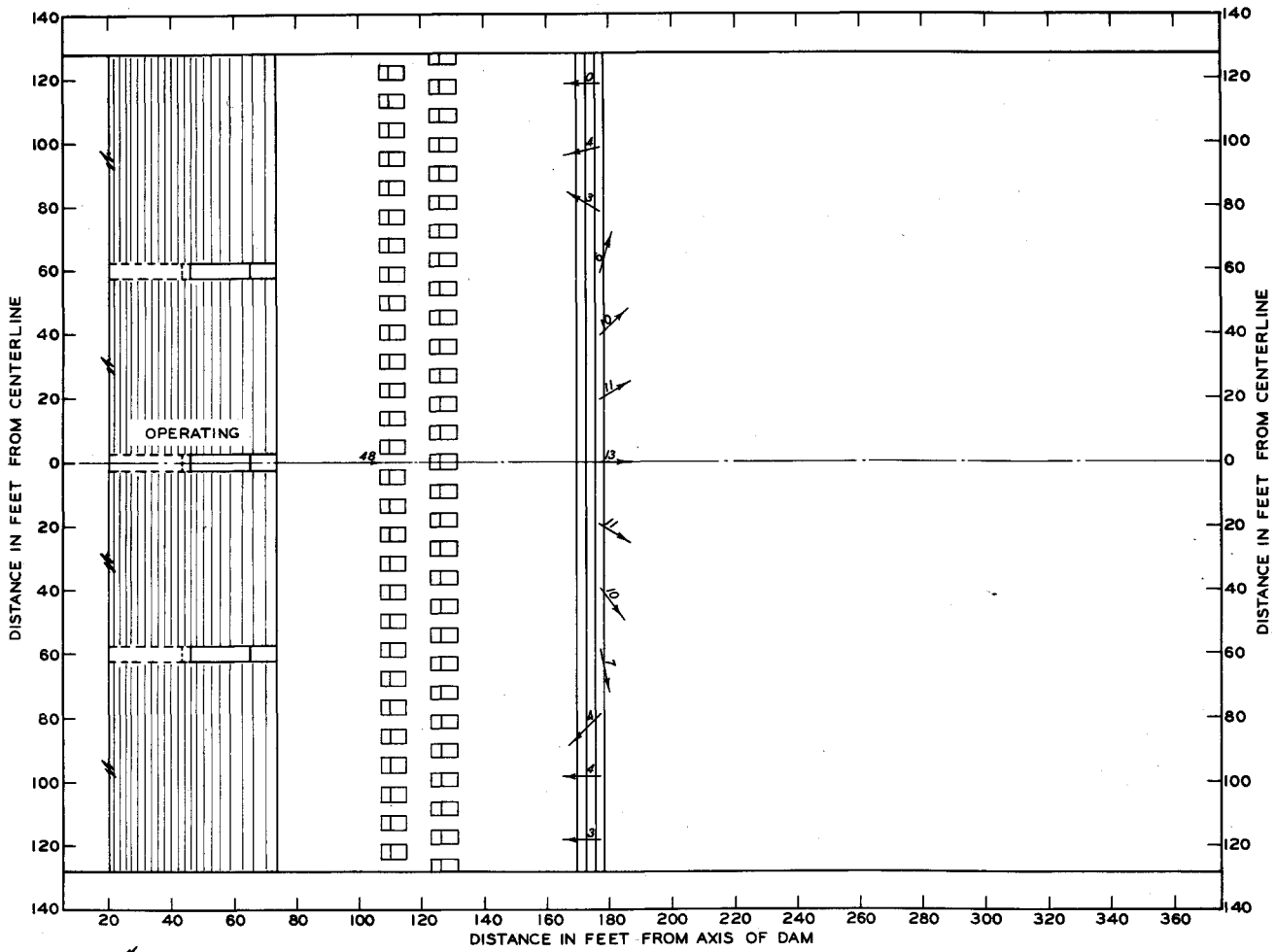
DISCHARGE	1,900 CFS
POOL ELEV	962.5
TAILWATER ELEV	912.0
TYPE I BASIN	
TYPE I SLUICE	

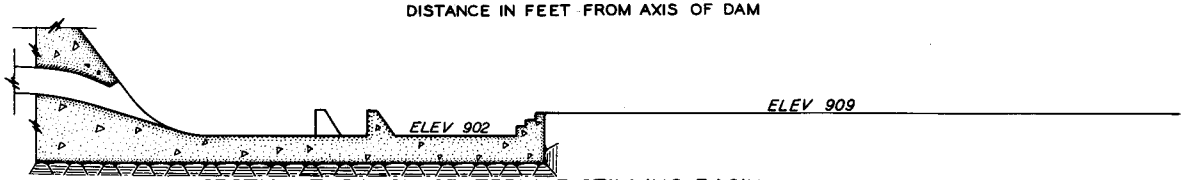
NOTE: BED OF EXIT CHANNEL MOLDED FLAT TO ELEVATION 909.0

MODEL STUDY OF SLUICES
FALL RIVER DAM
FALL RIVER, KANSAS

SCOUR PATTERN

PLATE 10





SECTION THROUGH CENTERLINE STILLING BASIN

TEST CONDITIONS

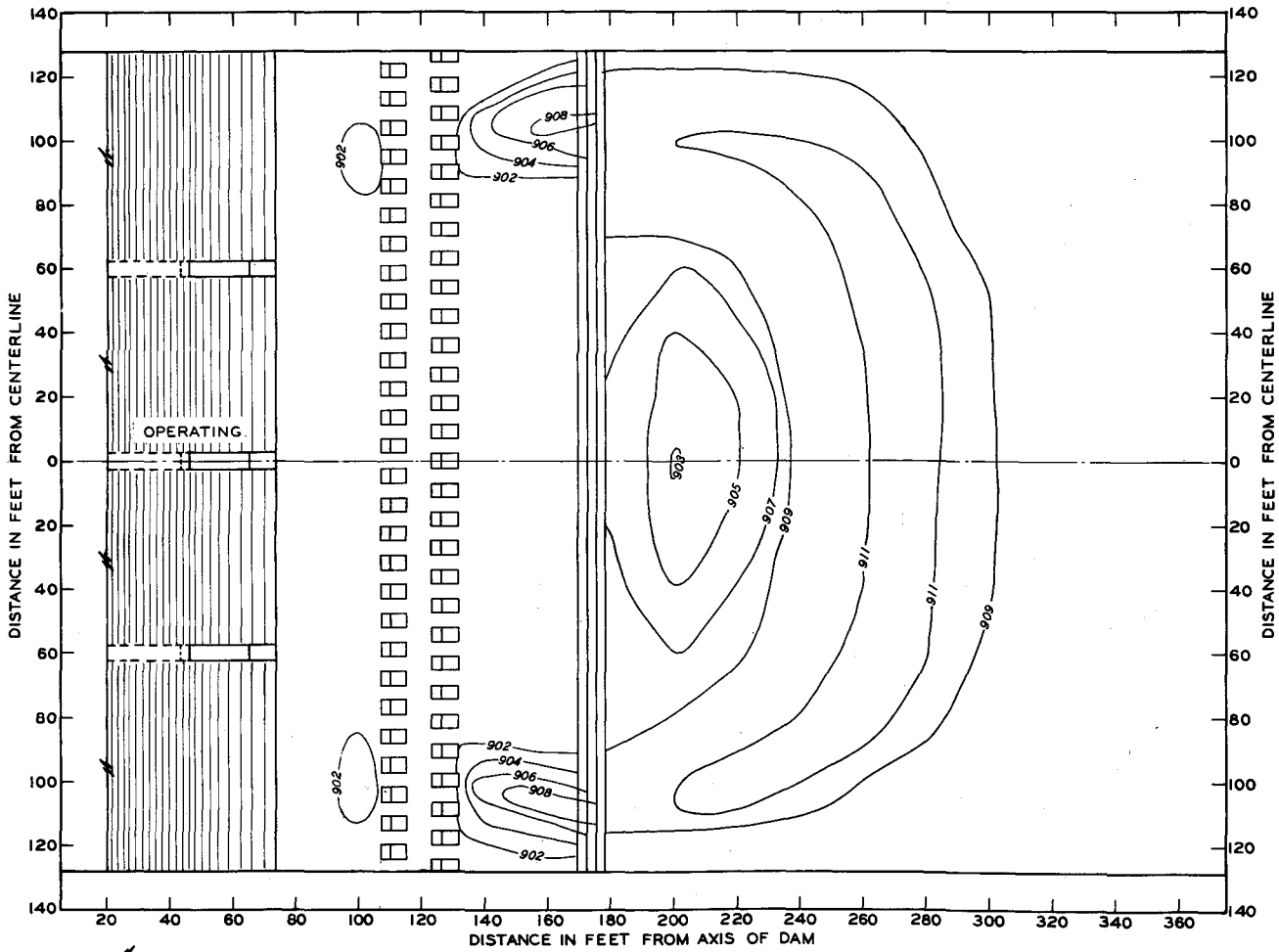
DISCHARGE	2,400 CFS
POOL ELEV	987.5
TAILWATER ELEV	912.8
TYPE I BASIN	
TYPE I SLUICE	

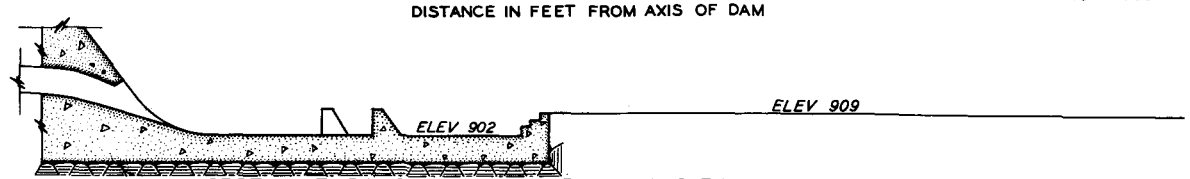
NOTE: BED OF EXIT CHANNEL FIXED IN CEMENT MORTAR AT ELEVATION 909.0.

MODEL STUDY OF SLUICES
FALL RIVER DAM
FALL RIVER, KANSAS

BOTTOM VELOCITIES

PLATE 11





SECTION THROUGH CENTERLINE STILLING BASIN

TEST CONDITIONS

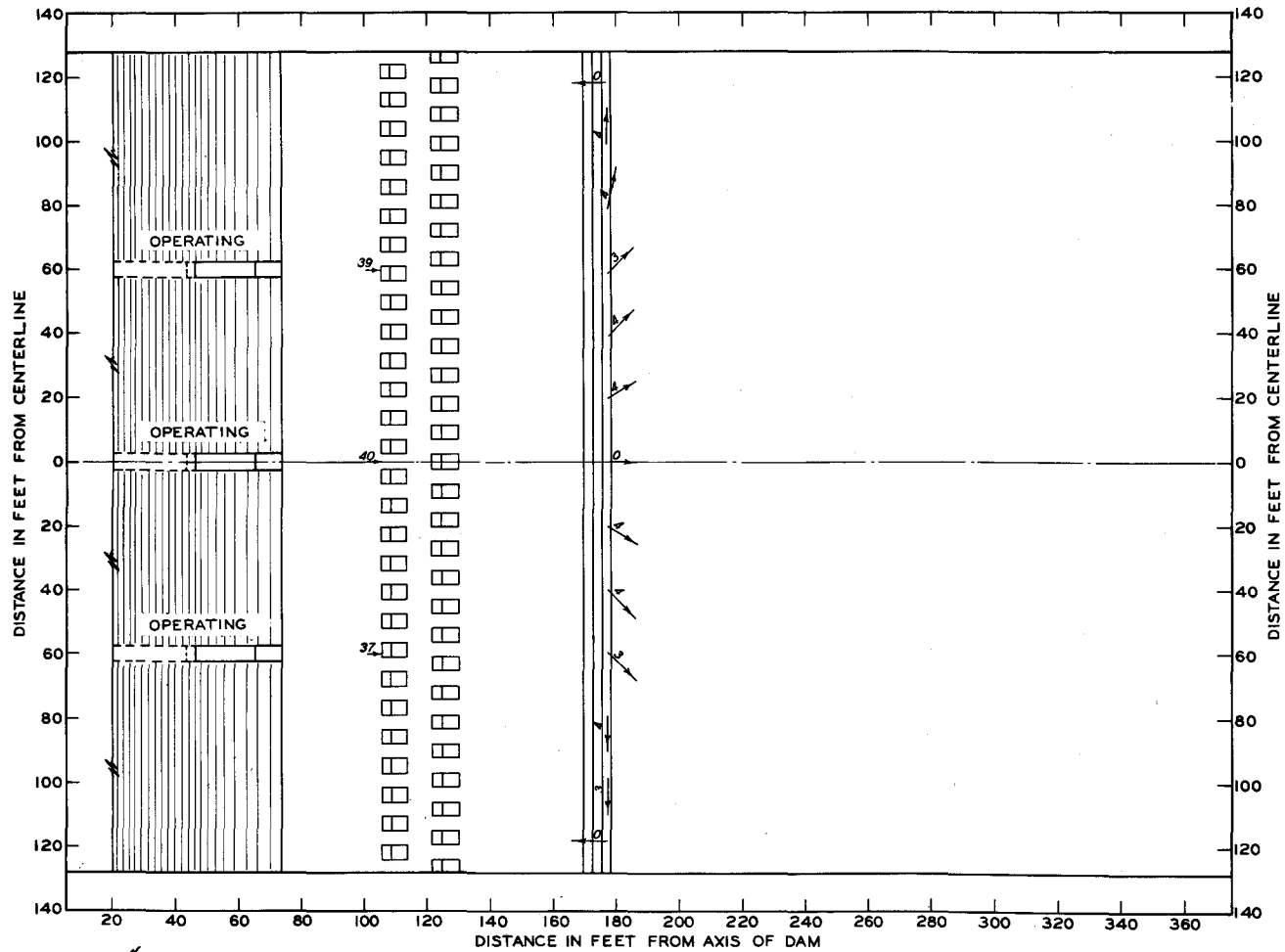
DISCHARGE	2,400 CFS
POOL ELEV	987.5
TAILWATER ELEV	912.8
TYPE I BASIN	
TYPE I SLUICE	

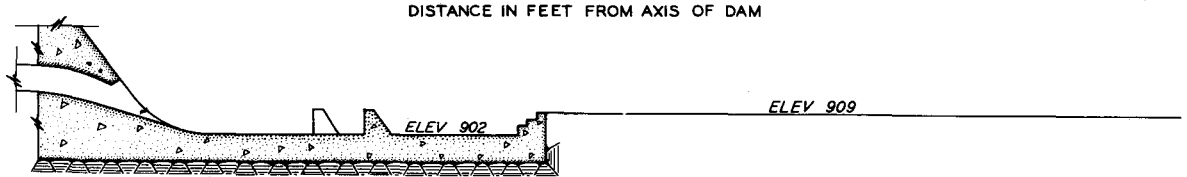
NOTE: BED OF EXIT CHANNEL MOLDED FLAT TO ELEVATION 909.0.

MODEL STUDY OF SLUICES
FALL RIVER DAM
FALL RIVER, KANSAS

SCOUR PATTERN

PLATE 12





SECTION THROUGH CENTERLINE STILLING BASIN

TEST CONDITIONS

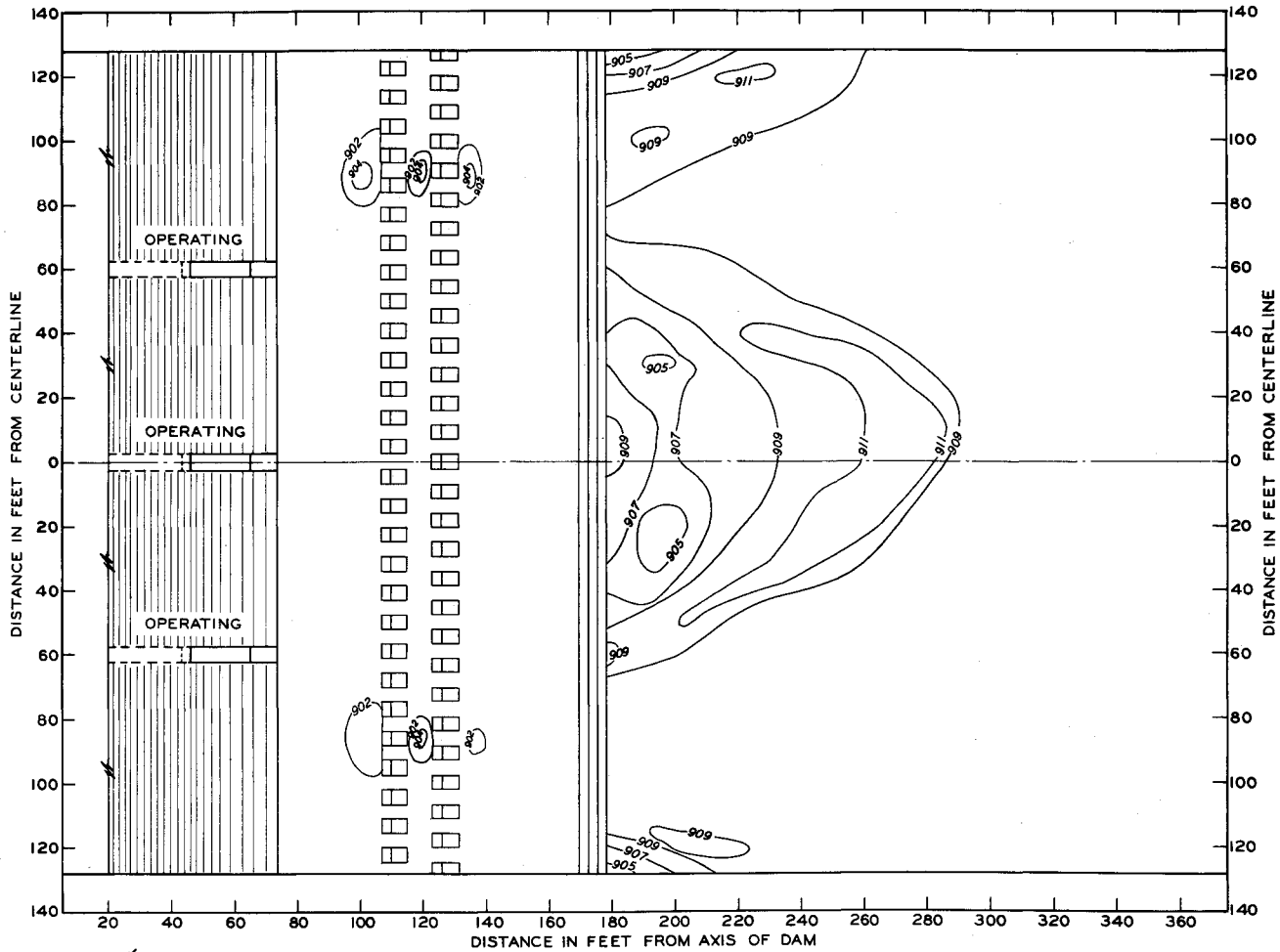
DISCHARGE	5,630 CFS
POOL ELEV	962.5
TAILWATER ELEV	916.8
TYPE I BASIN	
TYPE I SLUICE	

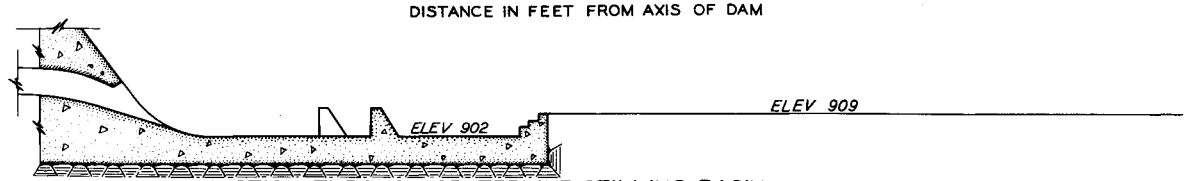
NOTE: BED OF EXIT CHANNEL FIXED IN CEMENT MORTAR AT ELEVATION 909.0

MODEL STUDY OF SLUICES
FALL RIVER DAM
FALL RIVER, KANSAS

BOTTOM VELOCITIES

PLATE 13





SECTION THROUGH CENTERLINE STILLING BASIN

TEST CONDITIONS

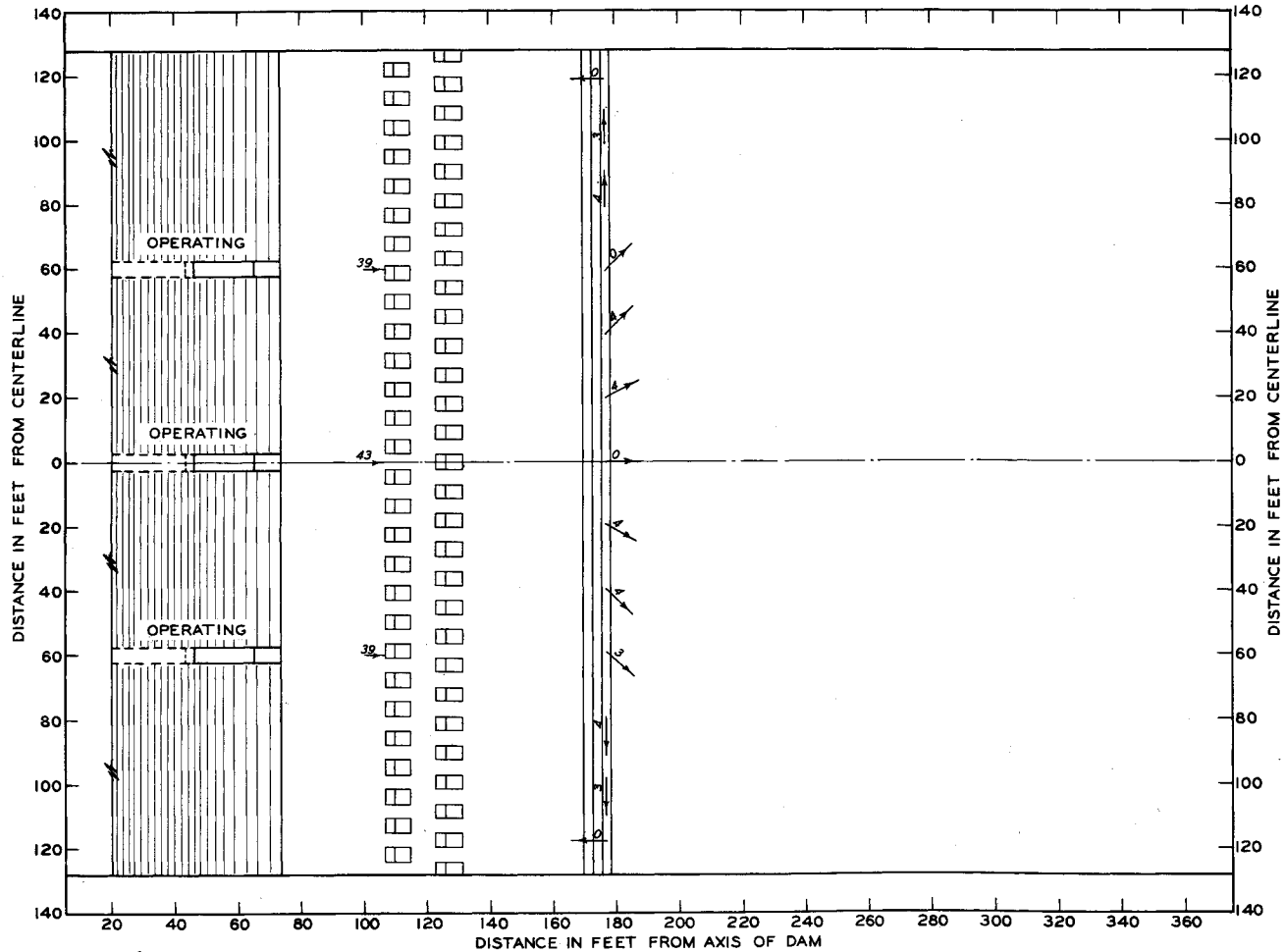
DISCHARGE	5,630 CFS
POOL ELEV	962.5
TAILWATER ELEV	916.8
TYPE I BASIN	
TYPE I SLUICE	

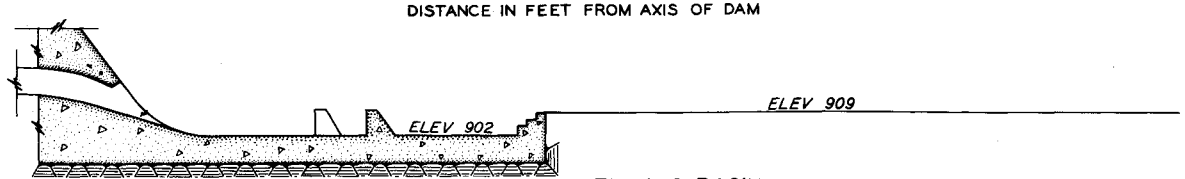
NOTE: BED OF EXIT CHANNEL MOLDED FLAT TO ELEVATION 909.0

MODEL STUDY OF SLUICES
FALL RIVER DAM
FALL RIVER, KANSAS

SCOUR PATTERN

PLATE 14





SECTION THROUGH CENTERLINE STILLING BASIN

TEST CONDITIONS

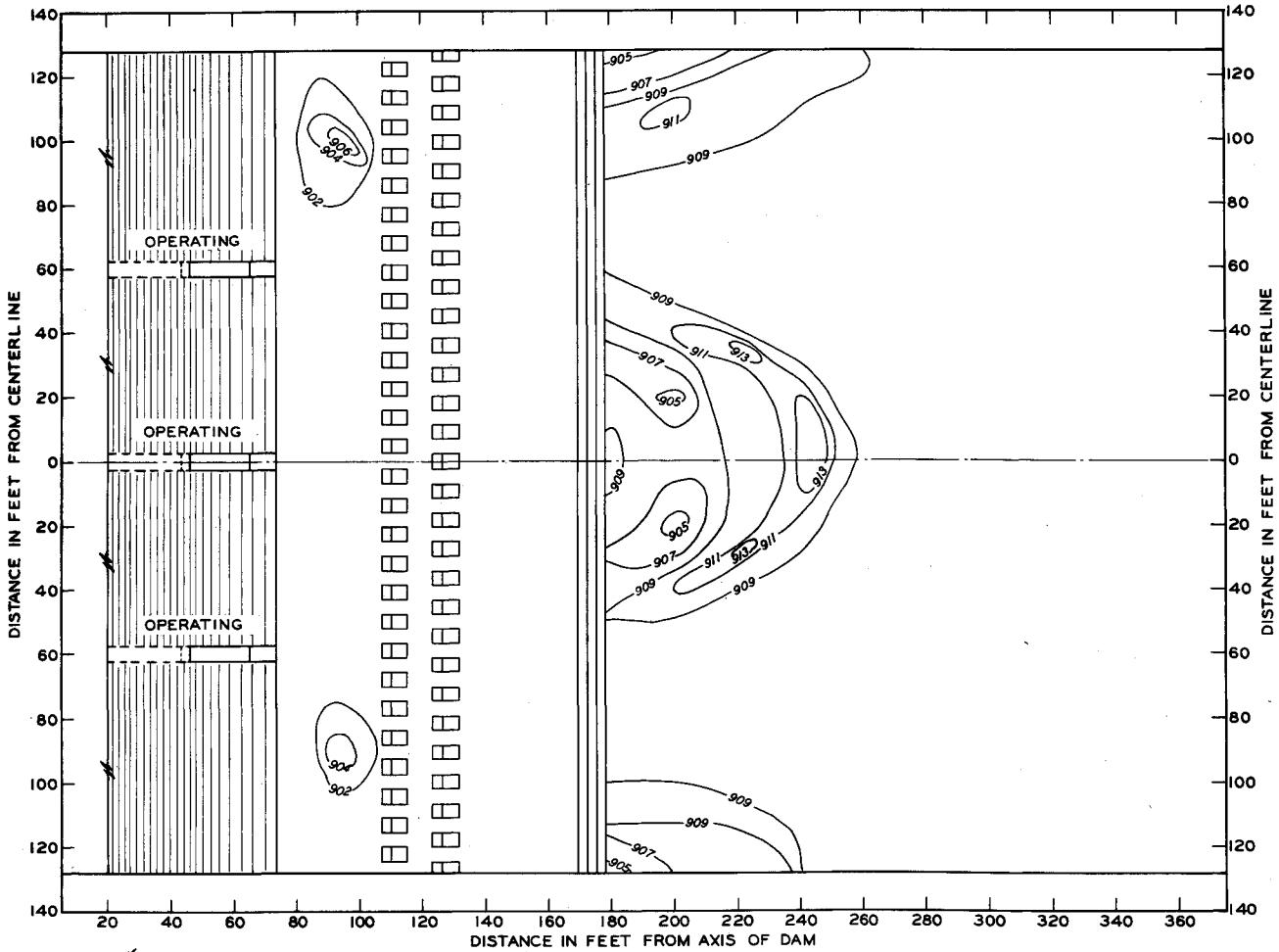
DISCHARGE	15,633 CFS
POOL ELEV	987.5
TAILWATER ELEV	925.2
TYPE I BASIN	
TYPE I SLUICE	

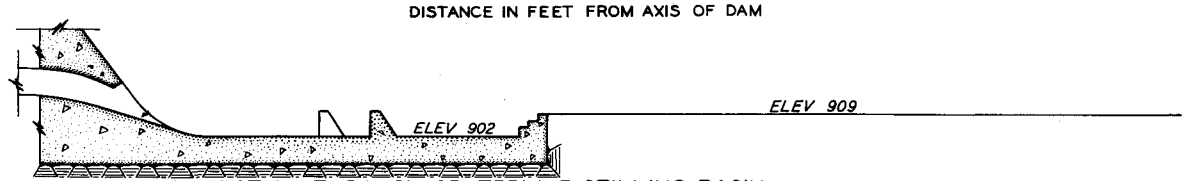
NOTE: BED OF EXIT CHANNEL FIXED IN CEMENT MORTAR AT ELEVATION 909.0.

MODEL STUDY OF SLUICES
FALL RIVER DAM
FALL RIVER, KANSAS

BOTTOM VELOCITIES

PLATE 15





SECTION THROUGH CENTERLINE STILLING BASIN

TEST CONDITIONS

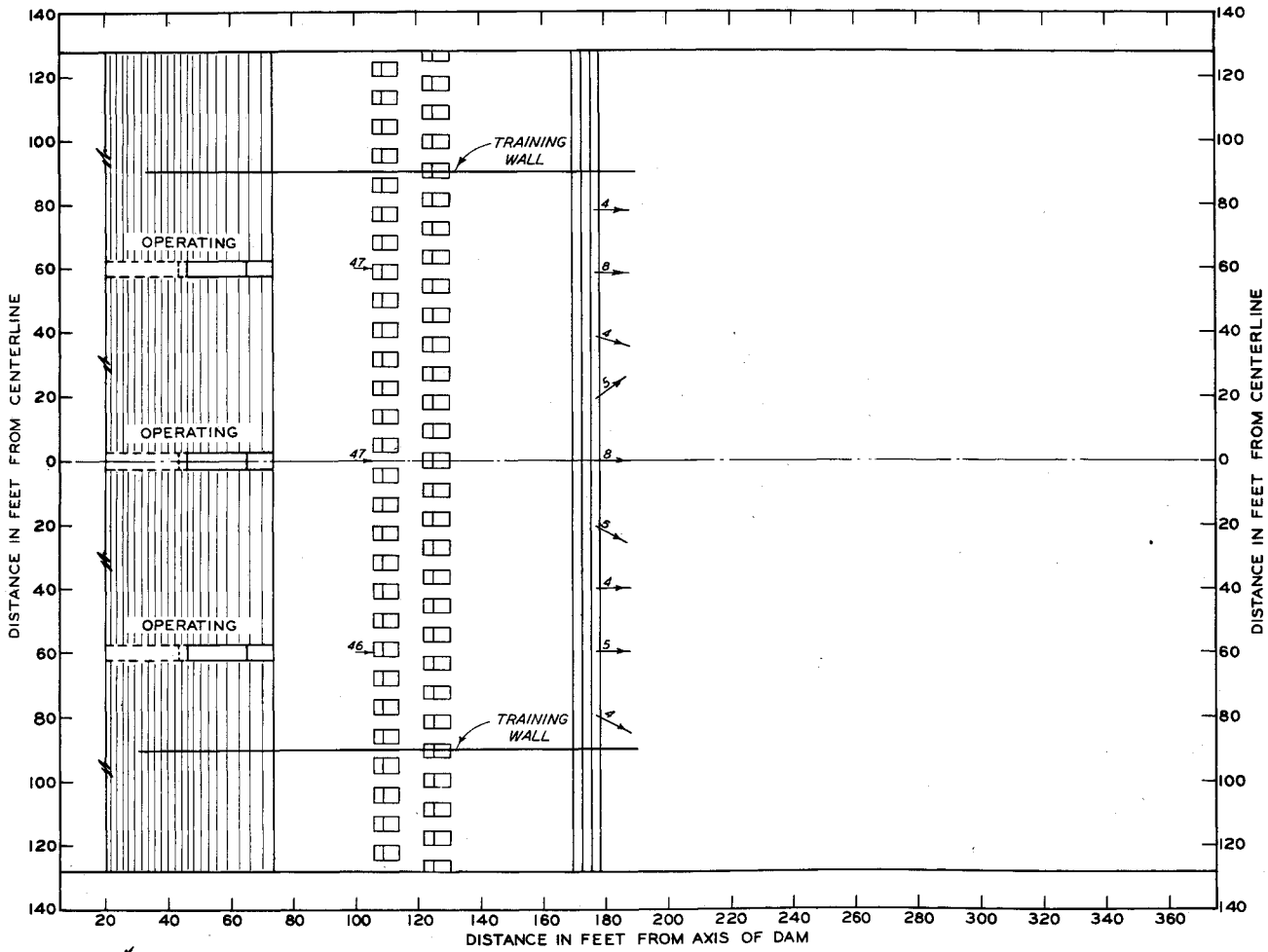
DISCHARGE	15,633 CFS
POOL ELEV	987.5
TAILWATER ELEV	925.2
TYPE I BASIN	
TYPE I SLUICE	

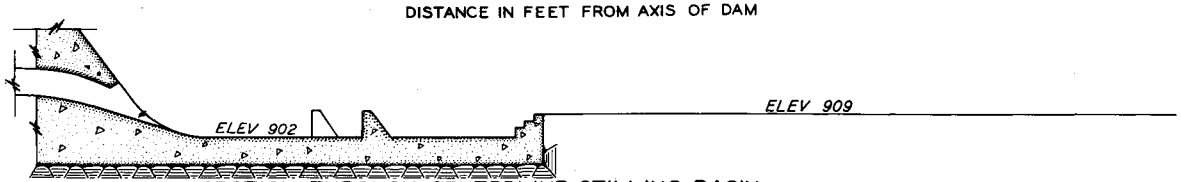
NOTE: BED OF EXIT CHANNEL MOLDED FLAT TO ELEVATION 909.0.

MODEL STUDY OF SLUICES
FALL RIVER DAM
FALL RIVER, KANSAS

SCOUR PATTERN

PLATE 16





SECTION THROUGH CENTERLINE STILLING BASIN

TEST CONDITIONS

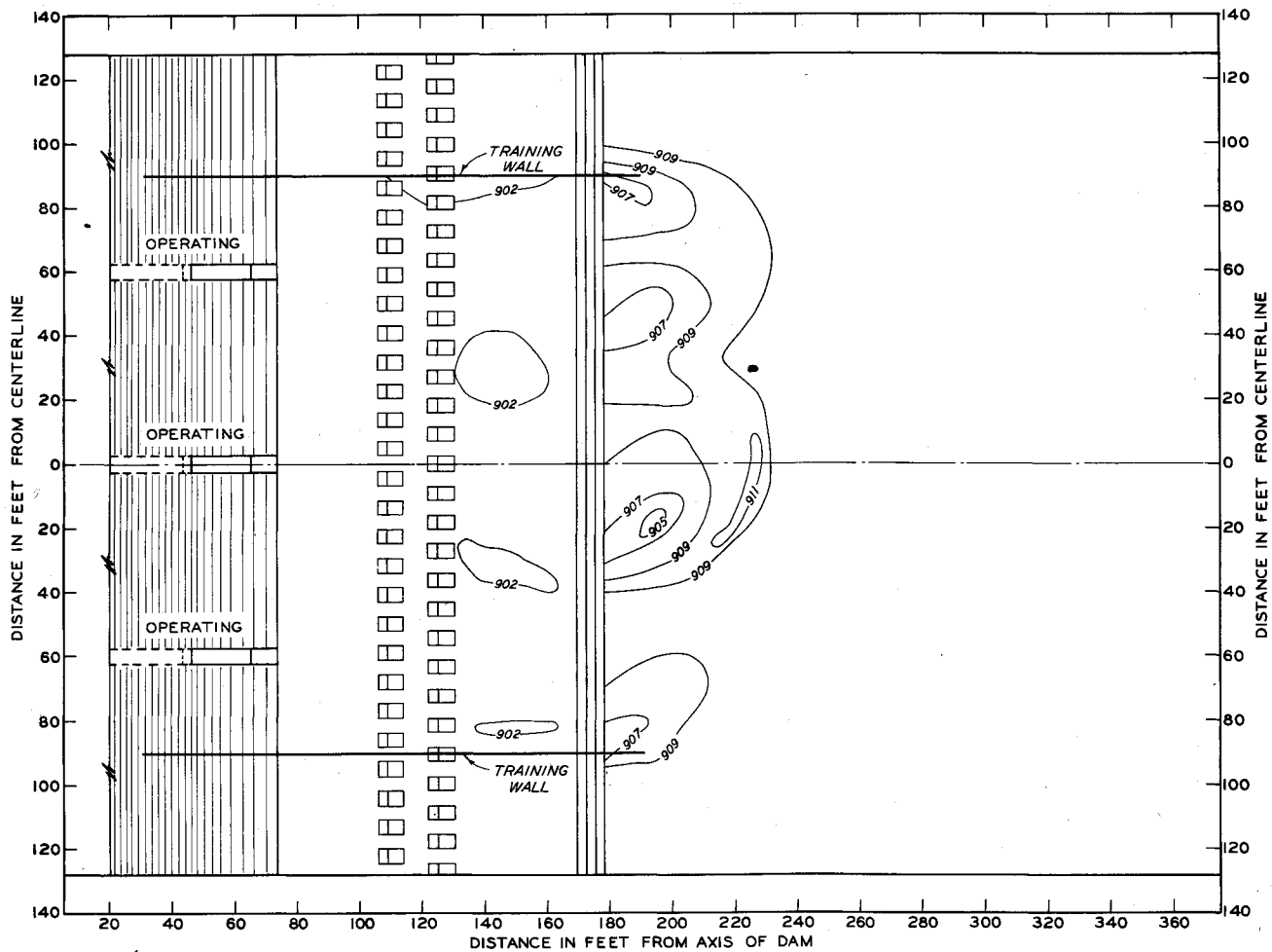
DISCHARGE	15,633 CFS
POOL ELEV	987.5
TAILWATER ELEV	925.2
TYPE I BASIN	
TYPE I SLUICE	

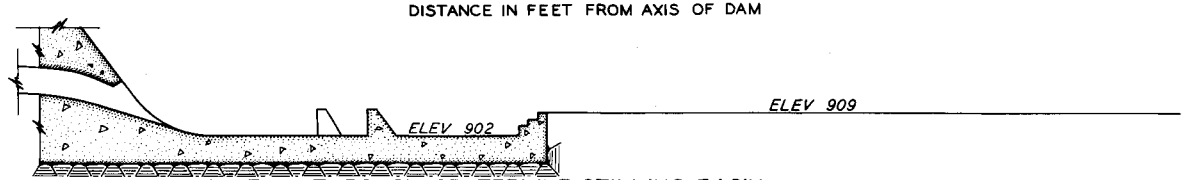
NOTE: BED OF EXIT CHANNEL FIXED IN CEMENT MORTAR AT ELEVATION 909.0.

MODEL STUDY OF SLUICES
FALL RIVER DAM
FALL RIVER, KANSAS

BOTTOM VELOCITIES

PLATE 17





SECTION THROUGH CENTERLINE STILLING BASIN

TEST CONDITIONS

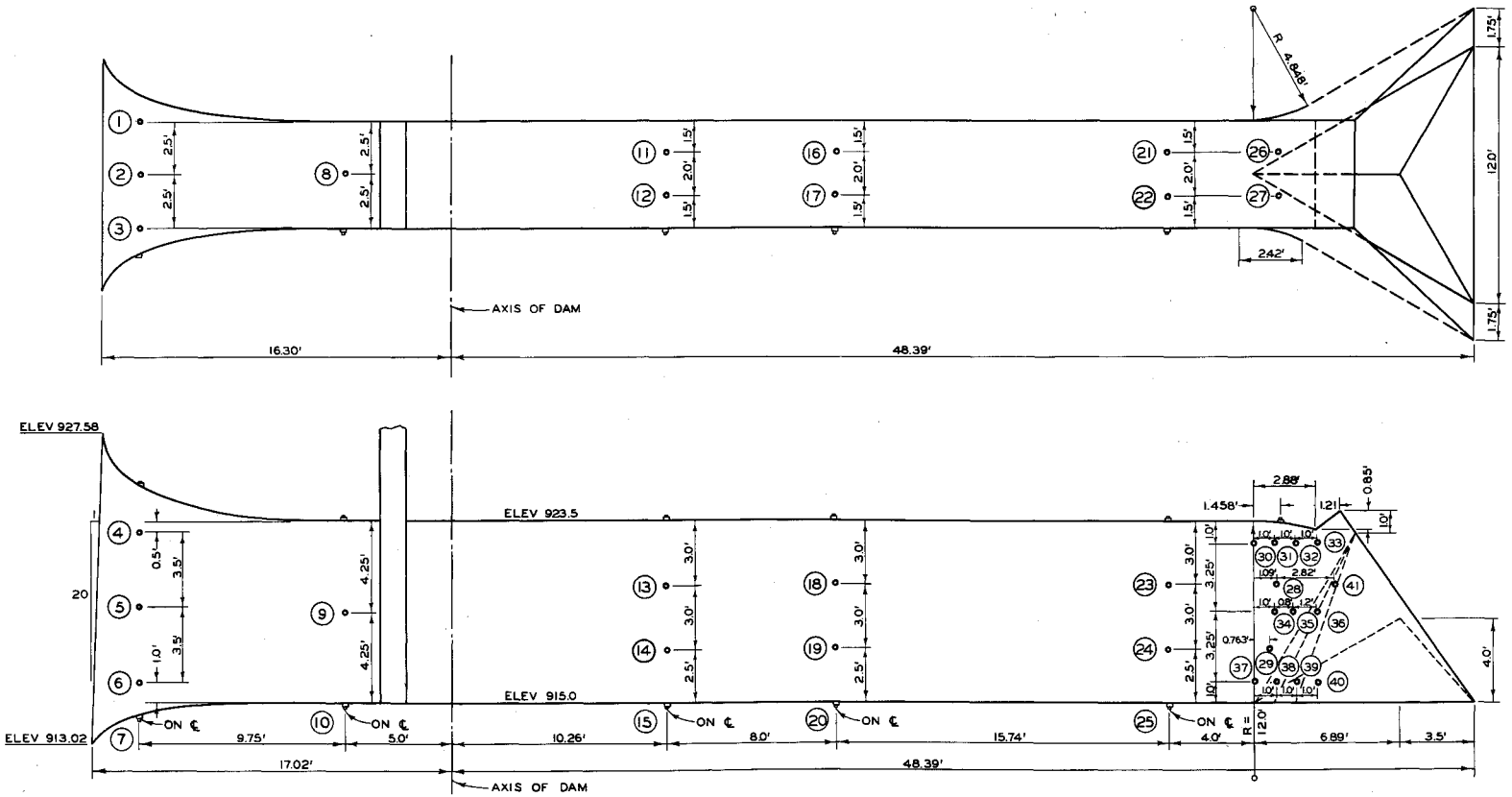
DISCHARGE	15,633 CFS
POOL ELEV	987.5
TAILWATER ELEV	925.2
TYPE I BASIN	
TYPE I SLUICE	

NOTE: BED OF EXIT CHANNEL MOLDED FLAT TO ELEVATION 909.0

MODEL STUDY OF SLUICES
FALL RIVER DAM
FALL RIVER, KANSAS

SCOUR PATTERN

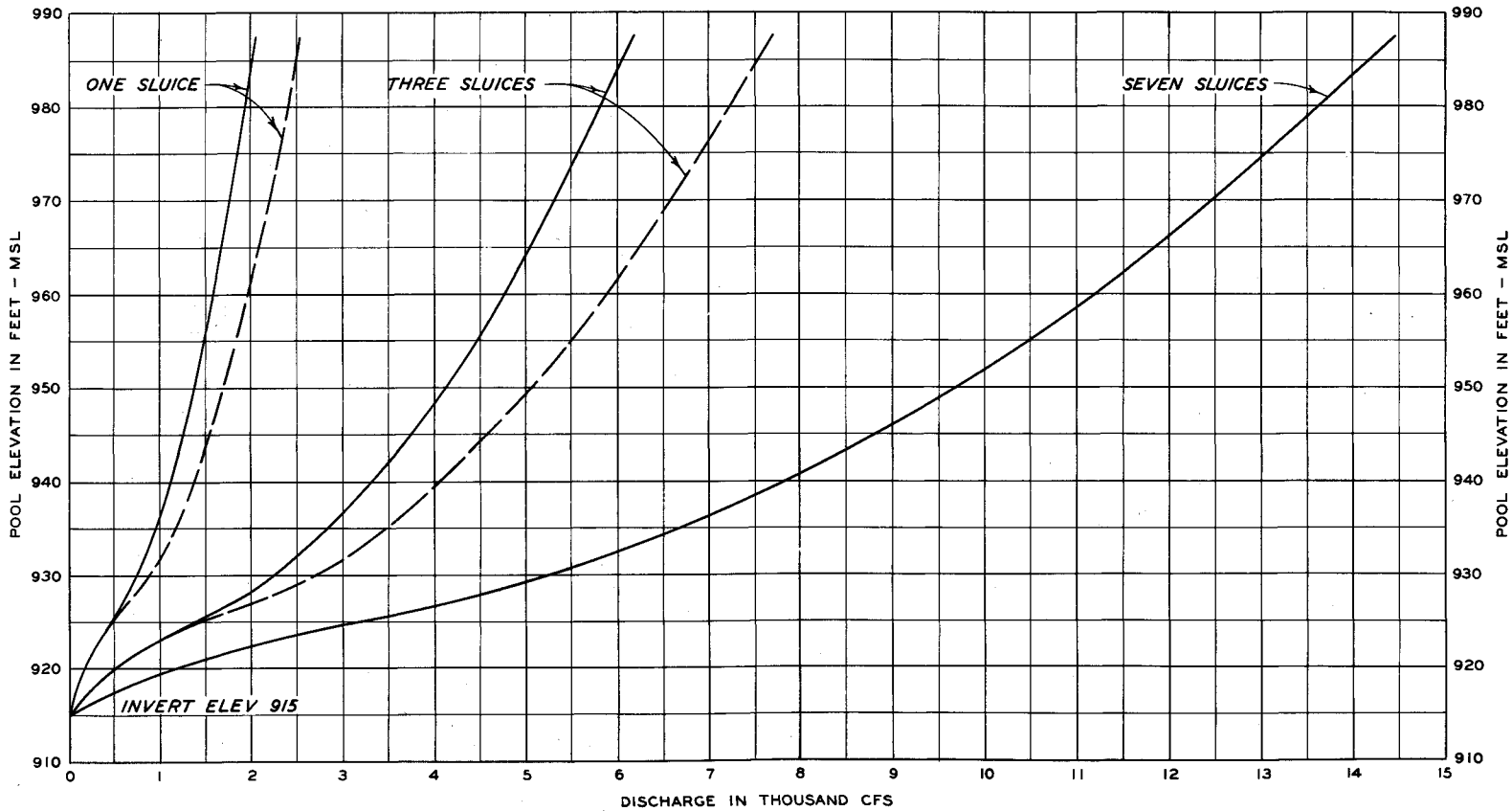
PLATE 18



MODEL STUDY OF SLUICES
FALL RIVER DAM
FALL RIVER, KANSAS

TYPE 2 DESIGN

PLATE 19



LEGEND

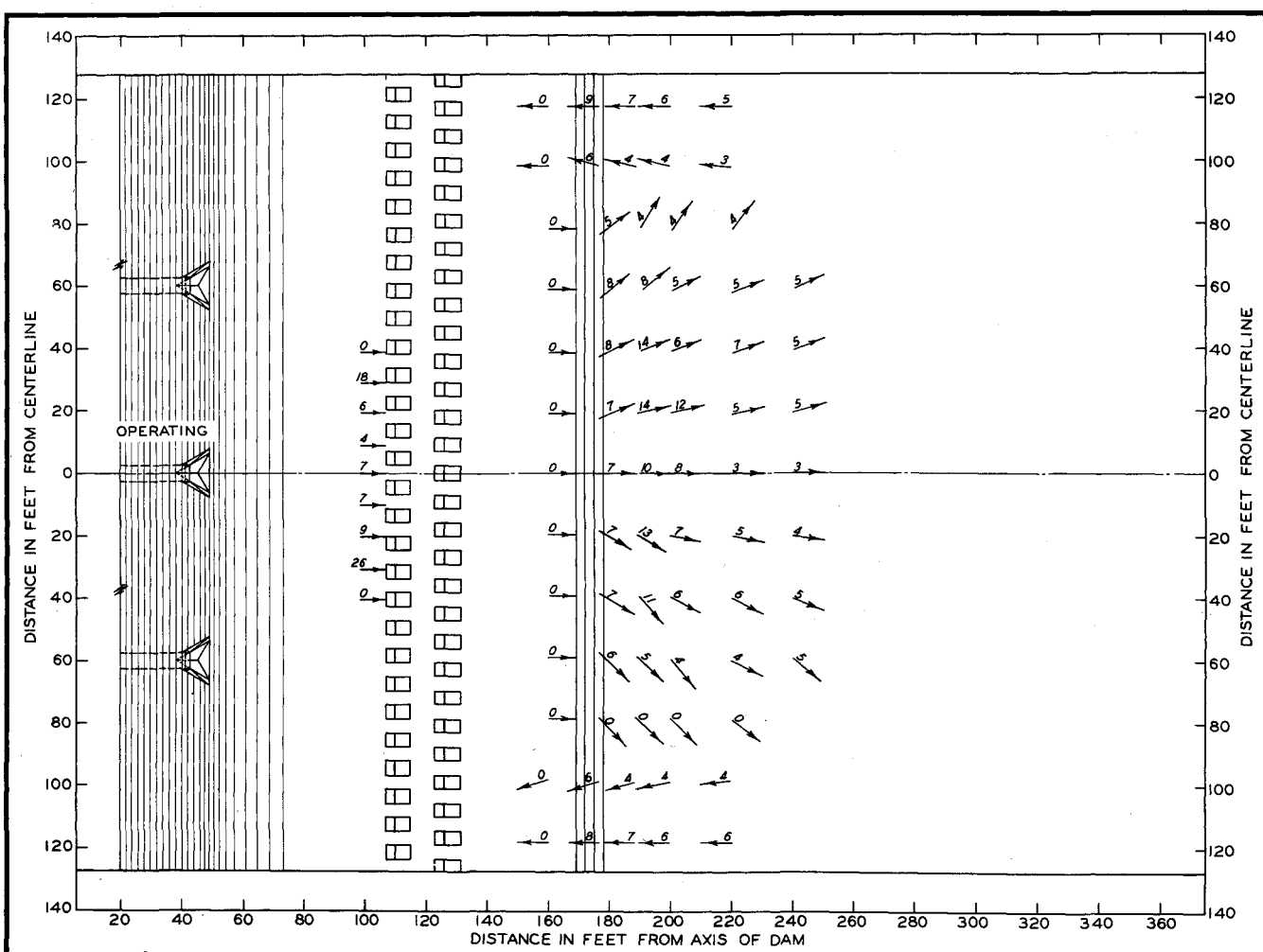
COMPUTED

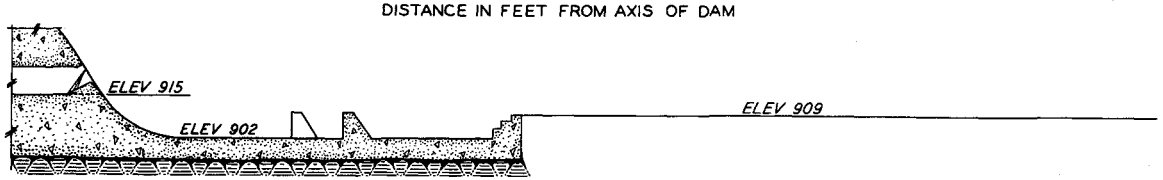
MODEL

MODEL STUDY OF SLUICES
FALL RIVER DAM
FALL RIVER, KANSAS

SLUICE RATING CURVES
TYPE 2 DESIGN

PLATE 20





SECTION THROUGH CENTERLINE STILLING BASIN

TEST CONDITIONS

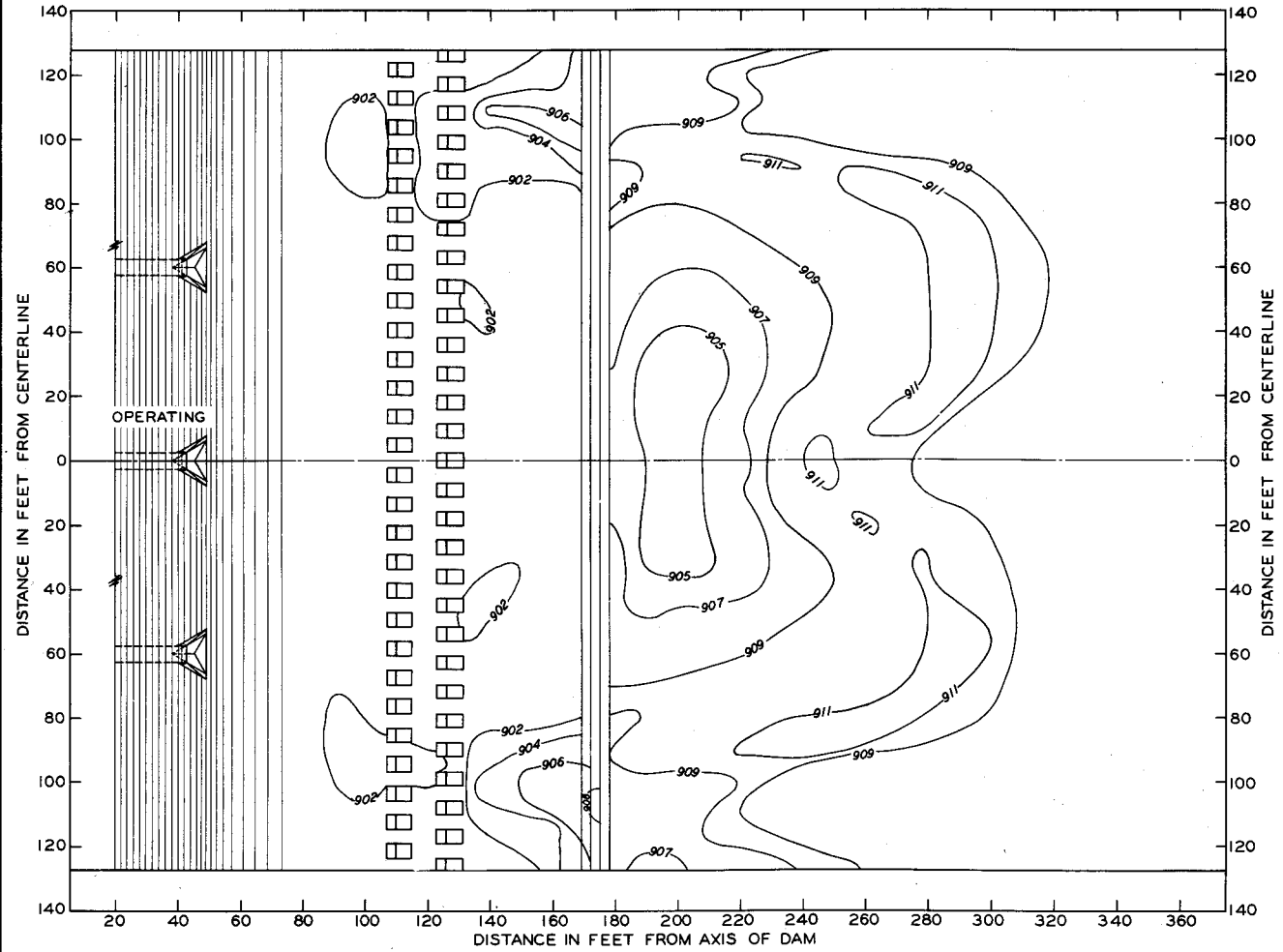
DISCHARGE	2,520 CFS
POOL ELEV	987.5
TAILWATER ELEV	912.8
TYPE I BASIN	
TYPE 2 SLUICE	

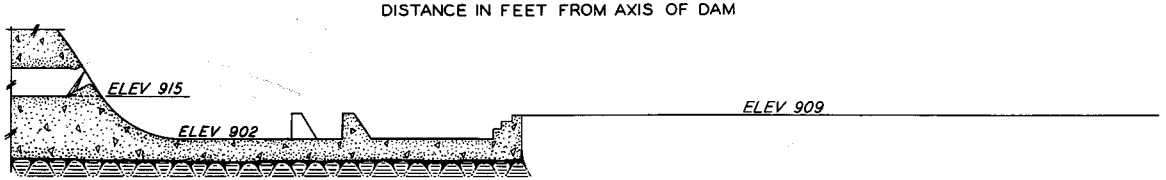
NOTE: BED OF EXIT CHANNEL FIXED IN CEMENT MORTAR AT ELEVATION 909.0

MODEL STUDY OF SLUICES
FALL RIVER DAM
FALL RIVER, KANSAS

BOTTOM VELOCITIES

PLATE 21





SECTION THROUGH CENTERLINE STILLING BASIN

TEST CONDITIONS

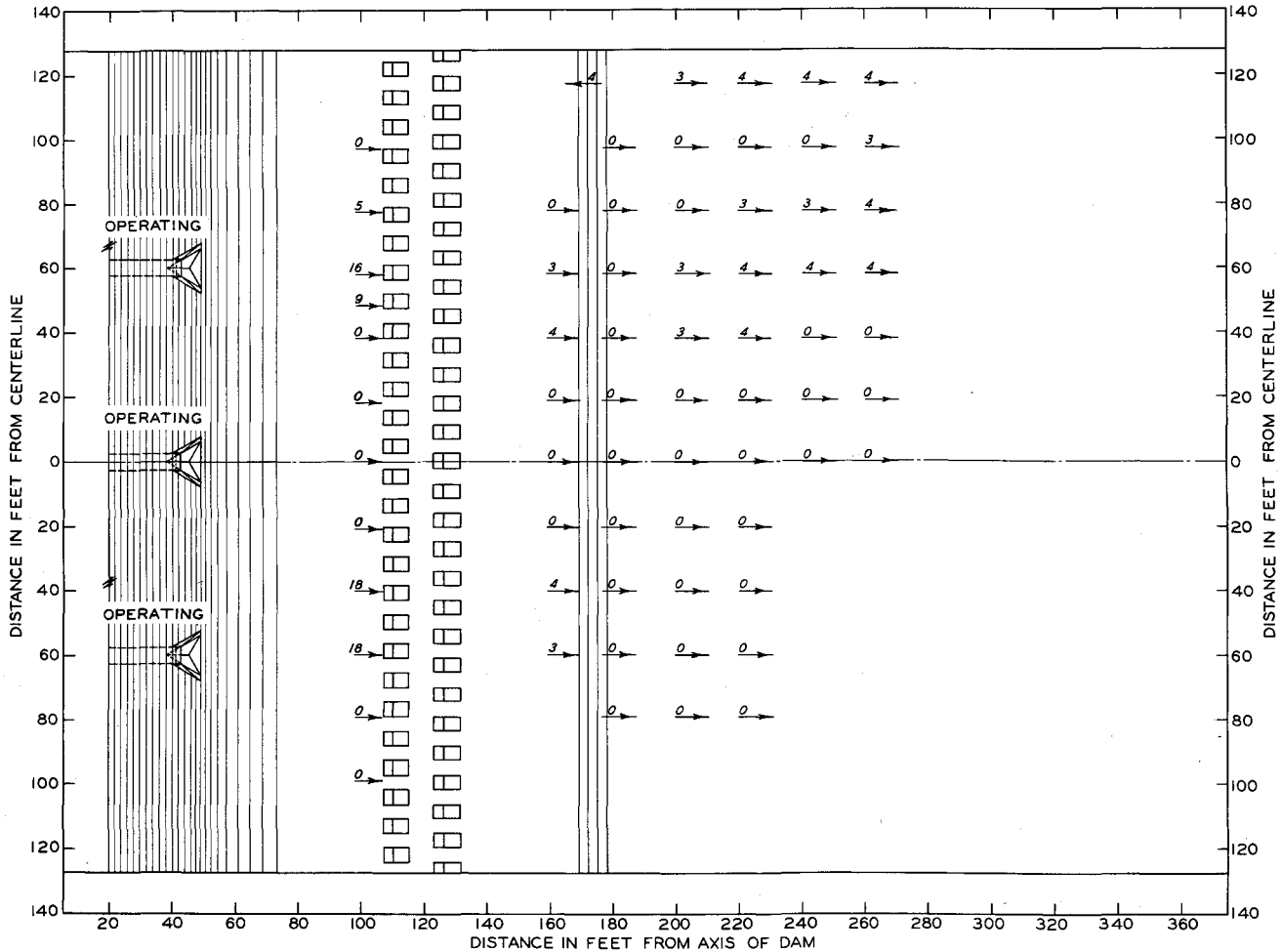
DISCHARGE	2,520 CFS
POOL ELEV	987.5
TAILWATER ELEV	912.8
TYPE I BASIN	
TYPE 2 SLUICE	

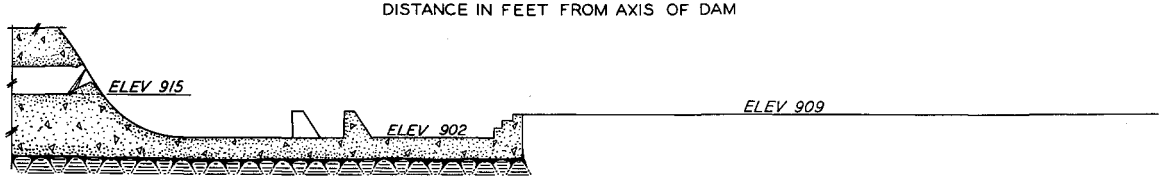
NOTE: BED OF EXIT CHANNEL MOLDED FLAT TO ELEVATION 909.0

MODEL STUDY OF SLUICES
FALL RIVER DAM
FALL RIVER, KANSAS

SCOUR PATTERN

PLATE 22





SECTION THROUGH CENTERLINE STILLING BASIN

TEST CONDITIONS

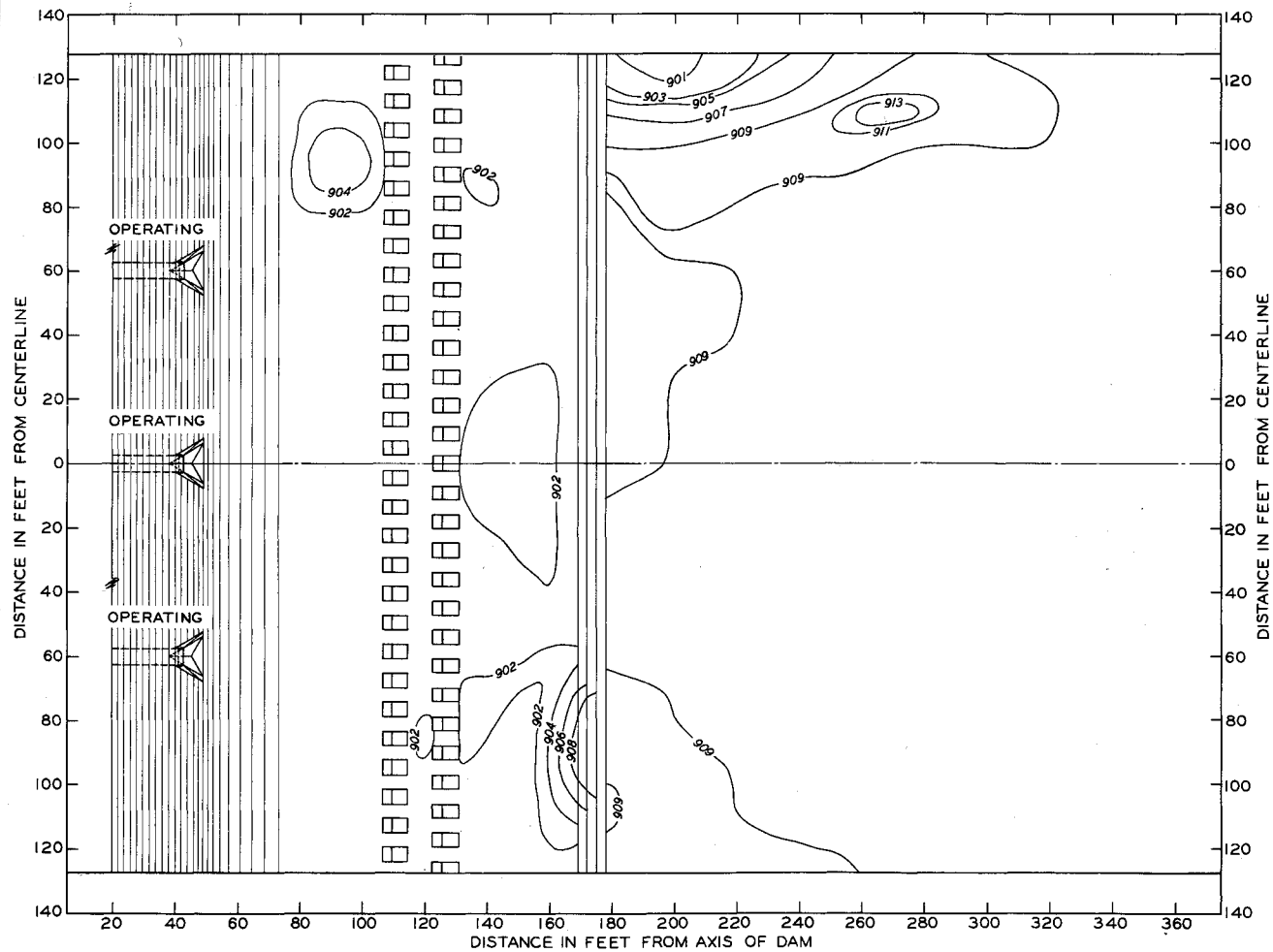
DISCHARGE	17,966 CFS
POOL ELEV	987.5
TAILWATER ELEV	925.8
TYPE 1 BASIN	
TYPE 2 SLUICE	

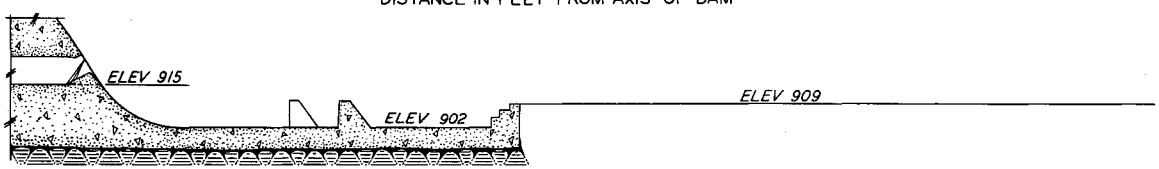
NOTE: BED OF EXIT CHANNEL FIXED IN CEMENT MORTAR AT ELEVATION 909.0

MODEL STUDY OF SLUICES
FALL RIVER DAM
FALL RIVER, KANSAS

BOTTOM VELOCITIES

PLATE 23





SECTION THROUGH CENTERLINE STILLING BASIN

TEST CONDITIONS

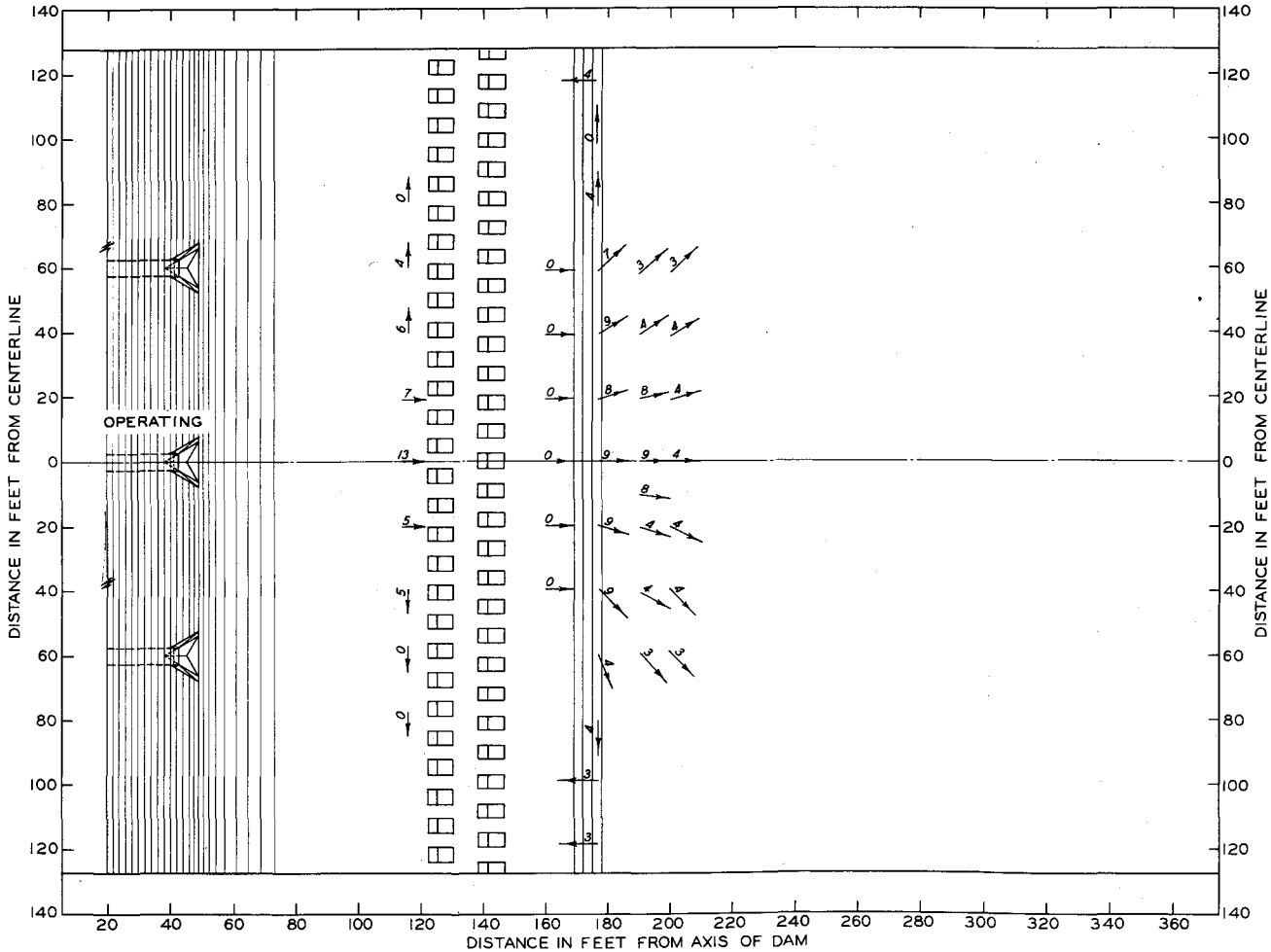
DISCHARGE	17,966 CFS
POOL ELEV	987.5
TAILWATER ELEV	925.8
TYPE 1 BASIN	
TYPE 2 SLUICE	

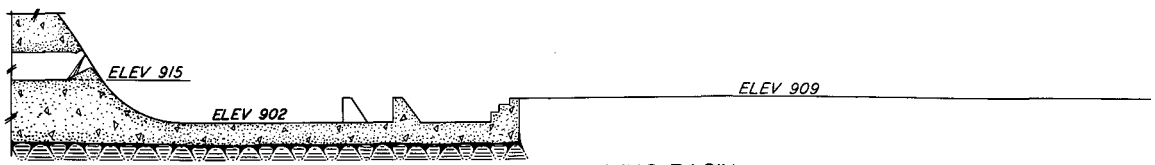
NOTE: BED OF EXIT CHANNEL MOLDED FLAT TO ELEVATION 909.0

MODEL STUDY OF SLUICES
FALL RIVER DAM
FALL RIVER, KANSAS

SCOUR PATTERN

PLATE 24





SECTION THROUGH CENTERLINE STILLING BASIN

TEST CONDITIONS

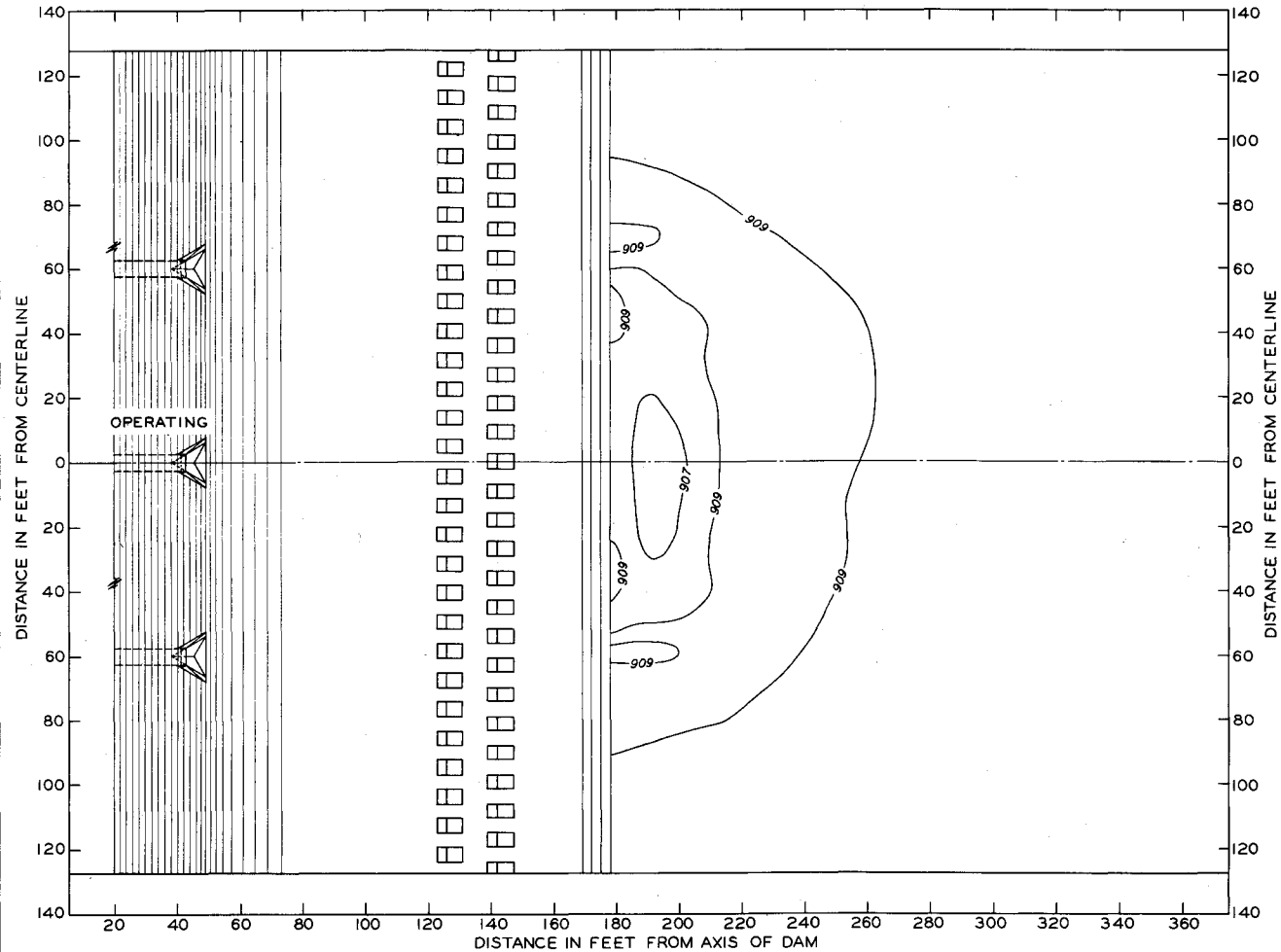
DISCHARGE	1,640 CFS
POOL ELEV	948.5
TAILWATER ELEV	911.6
TYPE 2 BASIN	
TYPE 2 SLUICE	

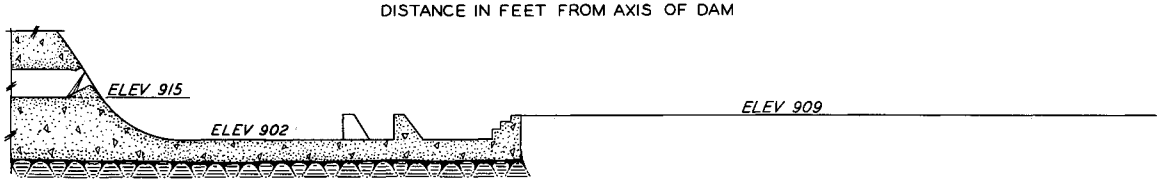
NOTE: BED OF EXIT CHANNEL FIXED IN CEMENT MORTAR AT ELEVATION 909.0

MODEL STUDY OF SLUICES
FALL RIVER DAM
FALL RIVER, KANSAS

BOTTOM VELOCITIES

PLATE 25





SECTION THROUGH CENTERLINE STILLING BASIN

TEST CONDITIONS

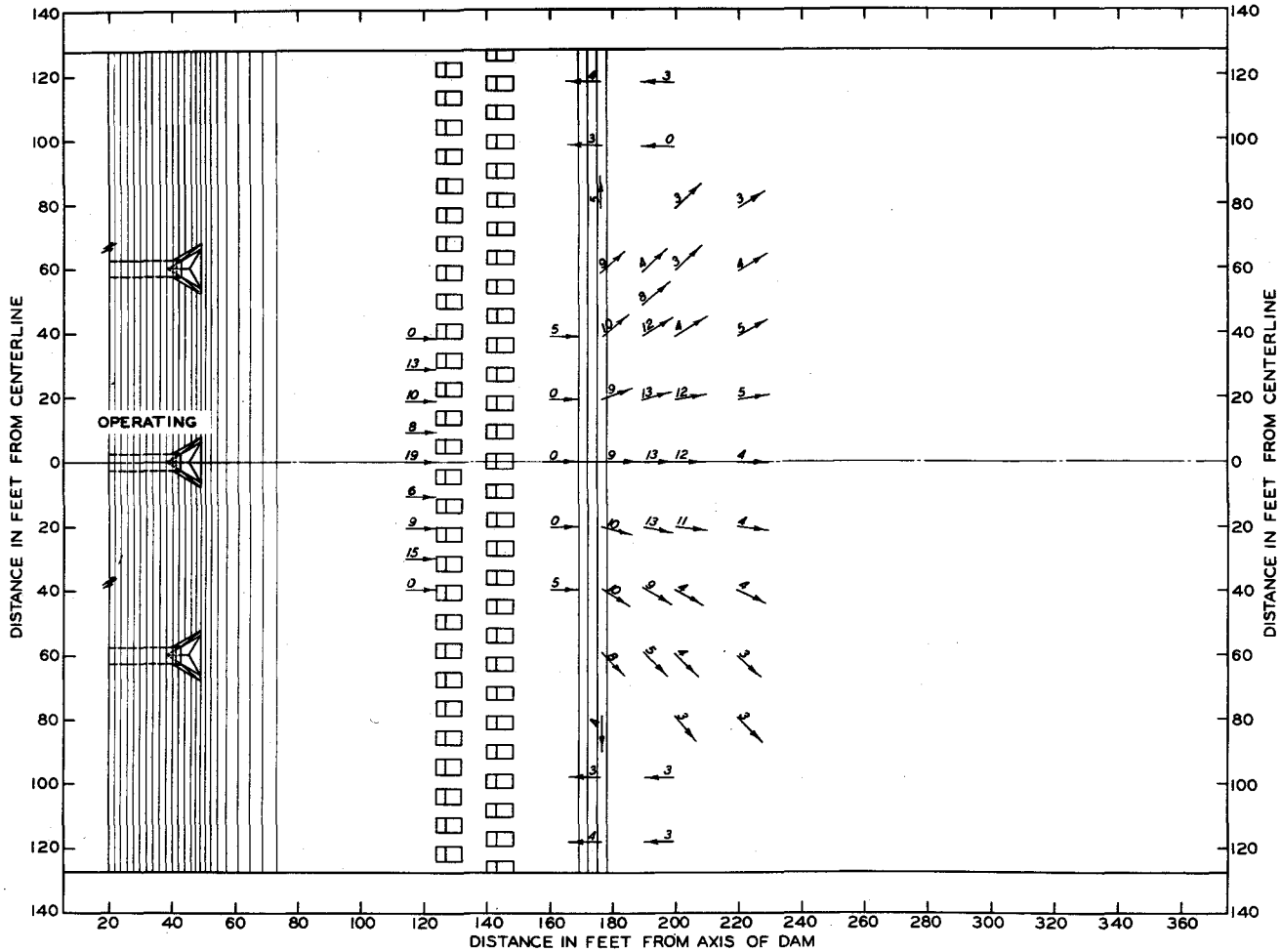
DISCHARGE	1,640 CFS
POOL ELEV	948.5
TAILWATER ELEV	911.6
TYPE 2 BASIN	
TYPE 2 SLUICE	

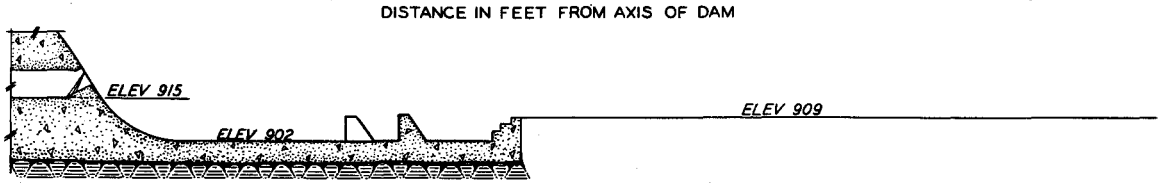
NOTE: BED OF EXIT CHANNEL MOLDED FLAT TO ELEVATION 909.0

MODEL STUDY OF SLUICES
FALL RIVER DAM
FALL RIVER, KANSAS

SCOUR PATTERN

PLATE 26





SECTION THROUGH CENTERLINE STILLING BASIN

TEST CONDITIONS

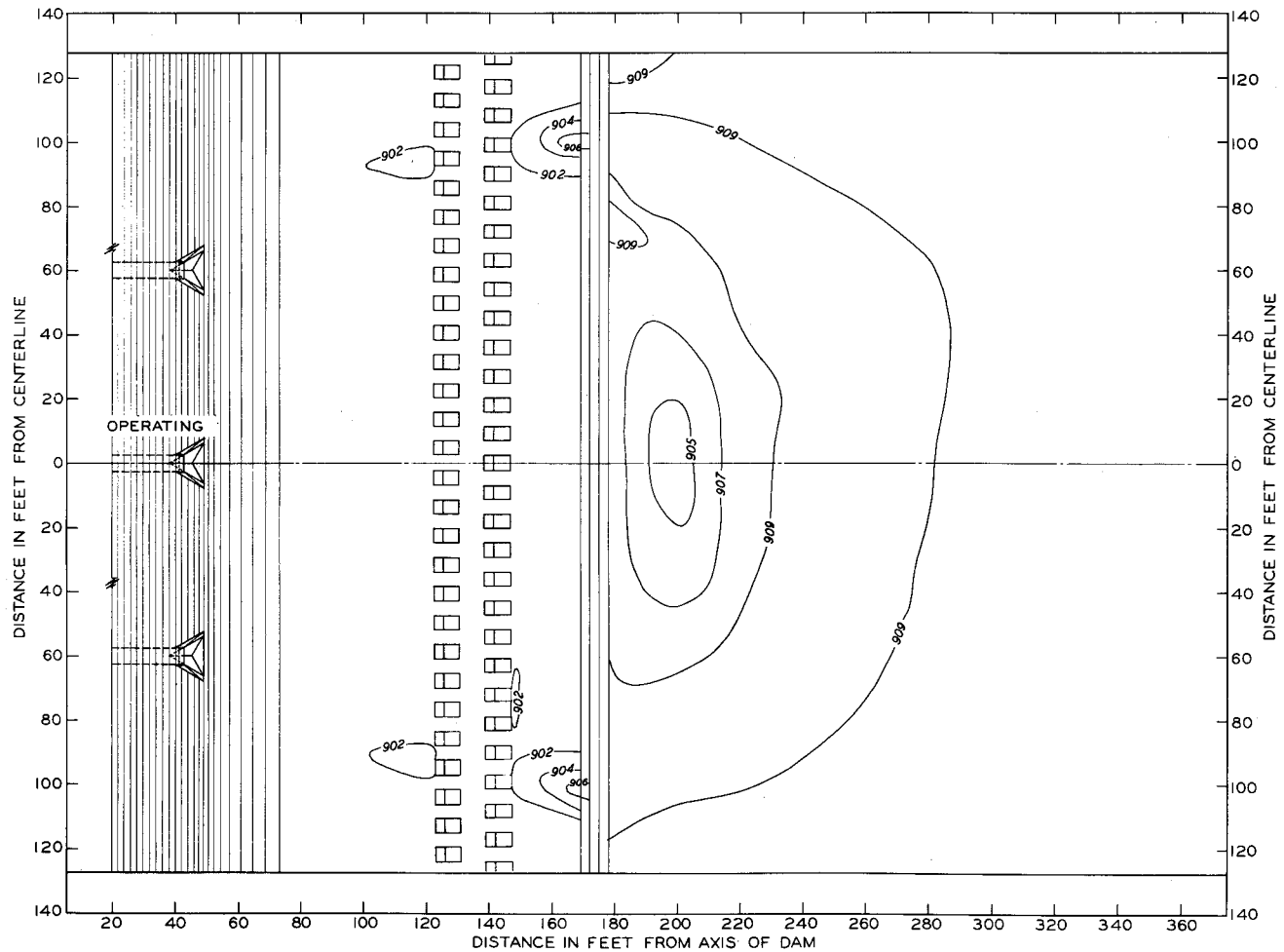
DISCHARGE	2,040 CFS
POOL ELEV	962.5
TAILWATER ELEV	912.3
TYPE 2 BASIN	
TYPE 2 SLUICE	

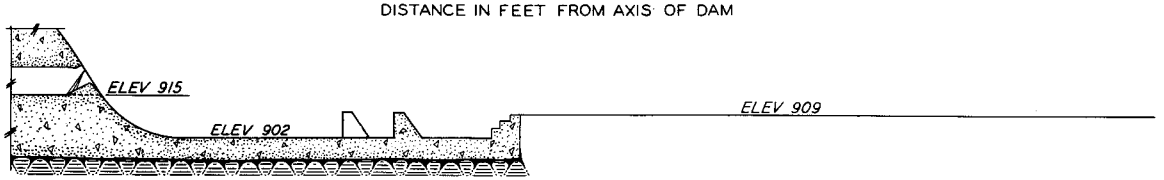
NOTE: BED OF EXIT CHANNEL FIXED IN CEMENT MORTAR AT ELEVATION 909.0

MODEL STUDY OF SLUICES
FALL RIVER DAM
FALL RIVER, KANSAS

BOTTOM VELOCITIES

PLATE 27





SECTION THROUGH CENTERLINE STILLING BASIN

TEST CONDITIONS

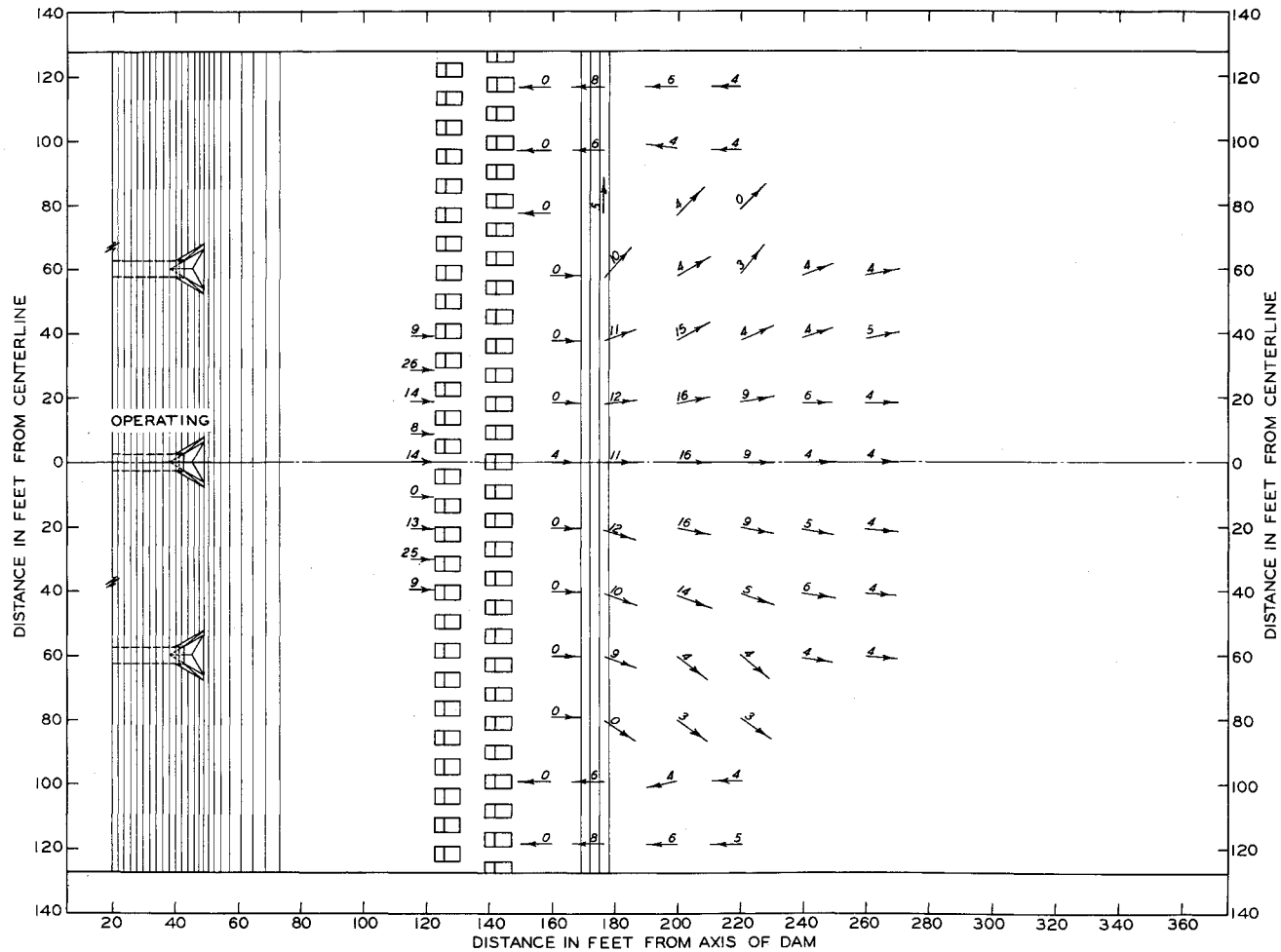
DISCHARGE	2,040 CFS
POOL ELEV	962.5
TAILWATER ELEV	912.3
TYPE 2 BASIN	
TYPE 2 SLUICE	

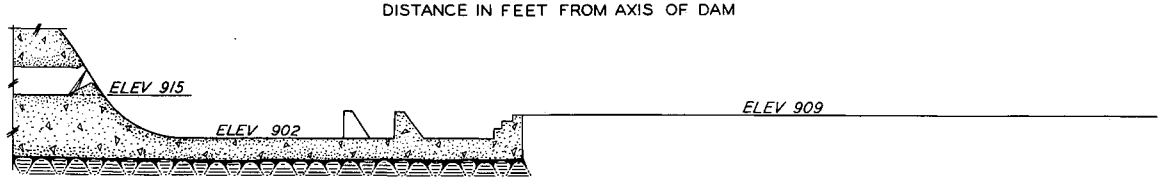
NOTE: BED OF EXIT CHANNEL MOLDED FLAT TO ELEVATION 909.0

MODEL STUDY OF SLUICES
FALL RIVER DAM
FALL RIVER, KANSAS

SCOUR PATTERN

PLATE 28





SECTION THROUGH CENTERLINE STILLING BASIN

TEST CONDITIONS

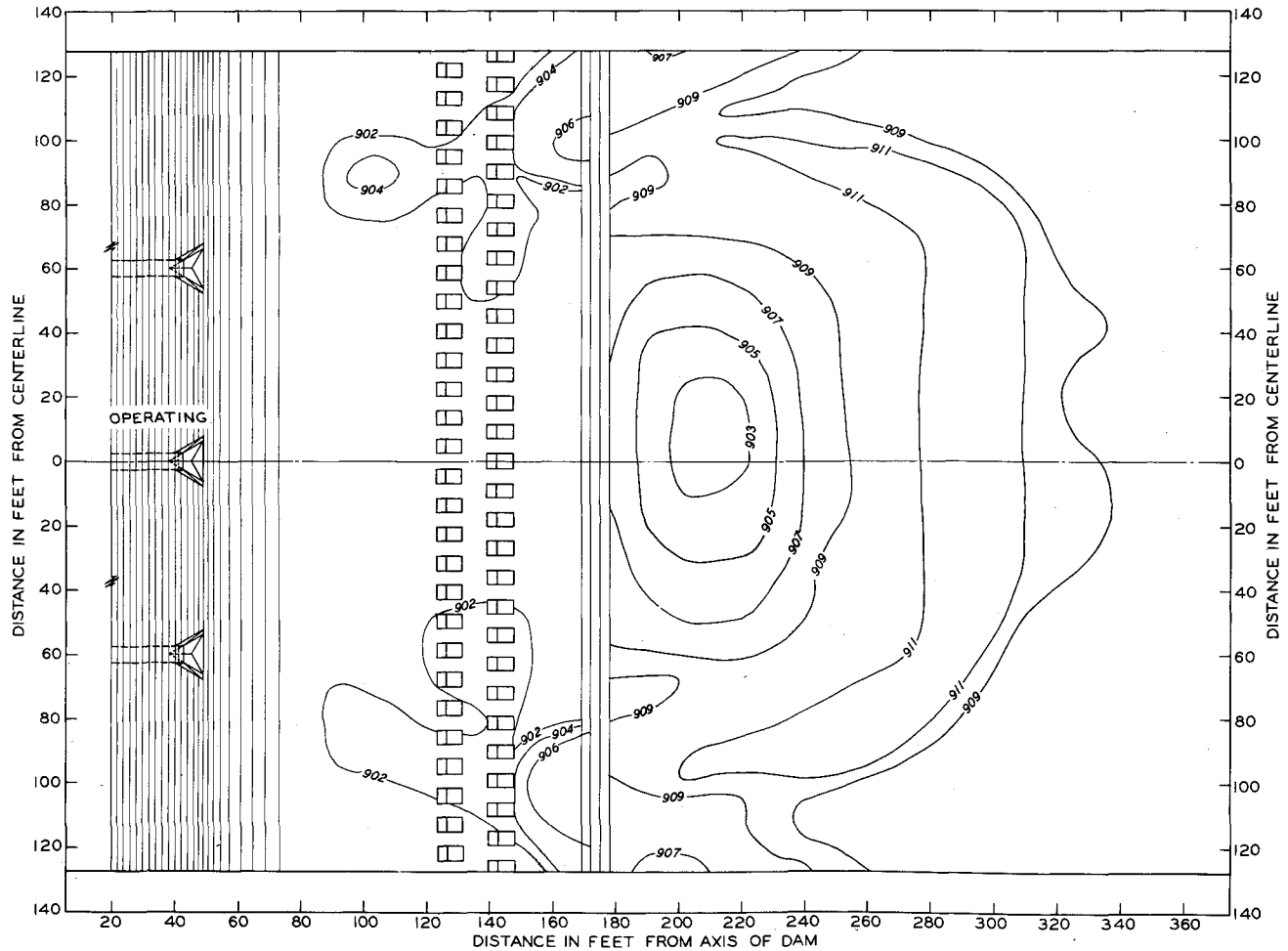
DISCHARGE	2,520 CFS
POOL ELEV	987.5
TAILWATER ELEV	912.8
TYPE 2 BASIN	
TYPE 2 SLUICE	

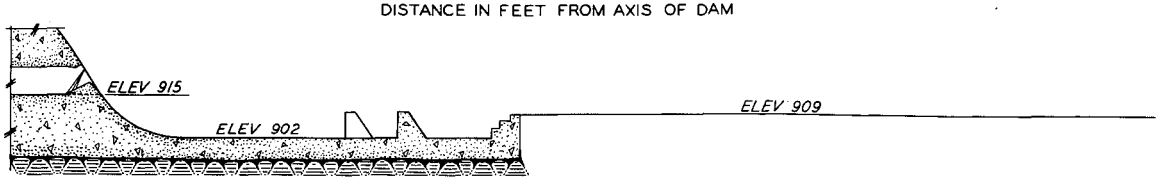
NOTE: BED OF EXIT CHANNEL FIXED IN CEMENT MORTAR AT ELEVATION 909.0.

MODEL STUDY OF SLUICES
FALL RIVER DAM
FALL RIVER, KANSAS

BOTTOM VELOCITIES

PLATE 29





SECTION THROUGH CENTERLINE STILLING BASIN

TEST CONDITIONS

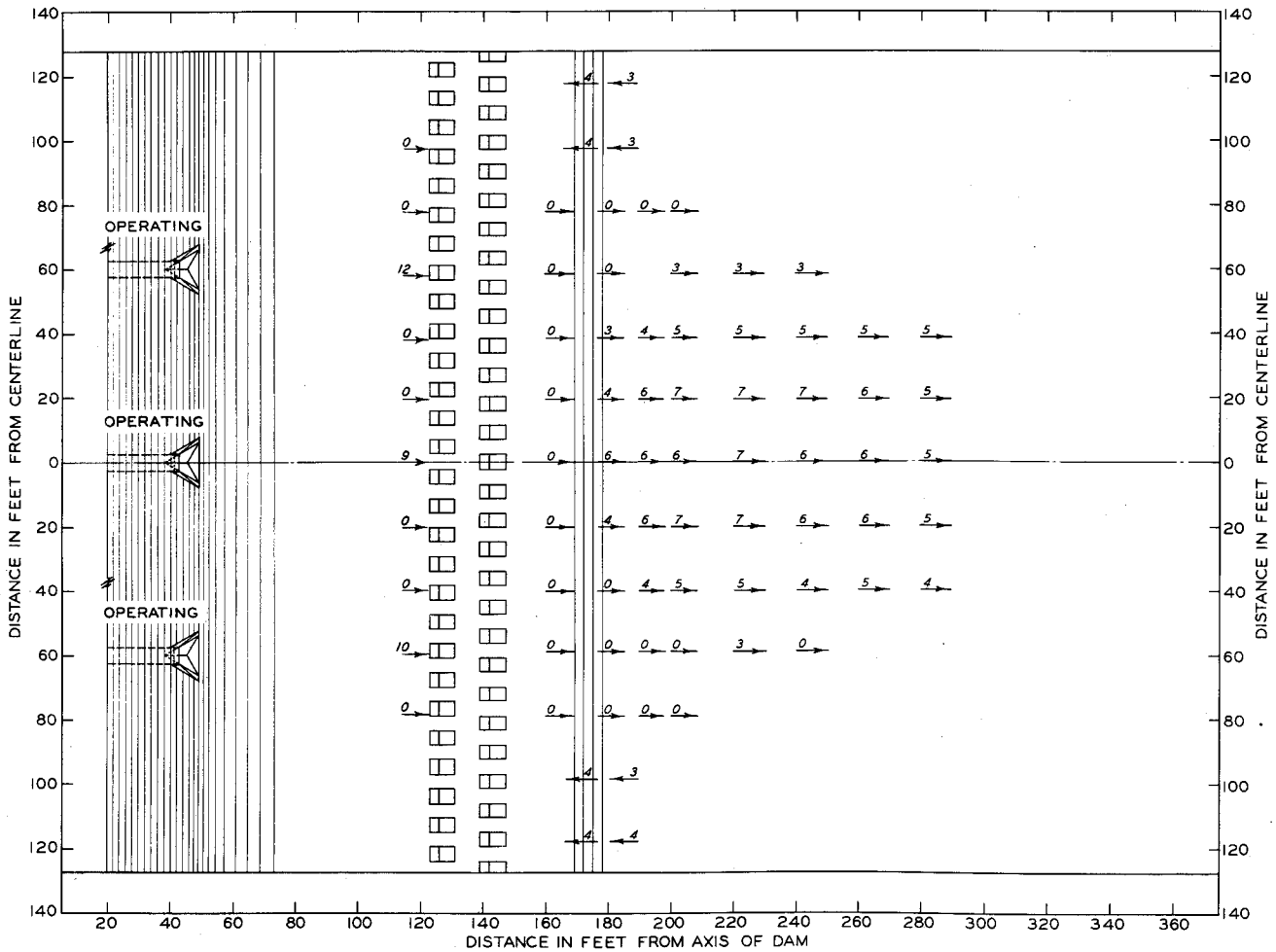
DISCHARGE	2,520 CFS
POOL ELEV	987.5
TAILWATER ELEV	912.8
TYPE 2 BASIN	
TYPE 2 SLUICE	

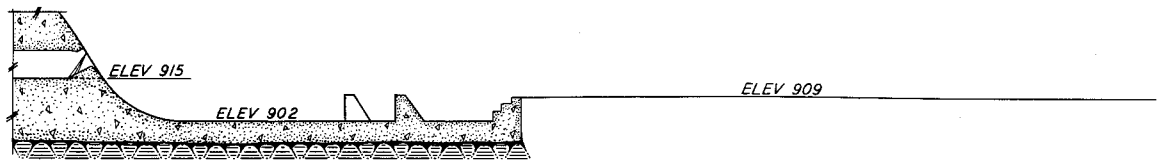
NOTE: BED OF EXIT CHANNEL MOLDED FLAT TO ELEVATION 909.0.

MODEL STUDY OF SLUICES
FALL RIVER DAM
FALL RIVER, KANSAS

SCOUR PATTERN

PLATE 30





SECTION THROUGH CENTERLINE STILLING BASIN

TEST CONDITIONS

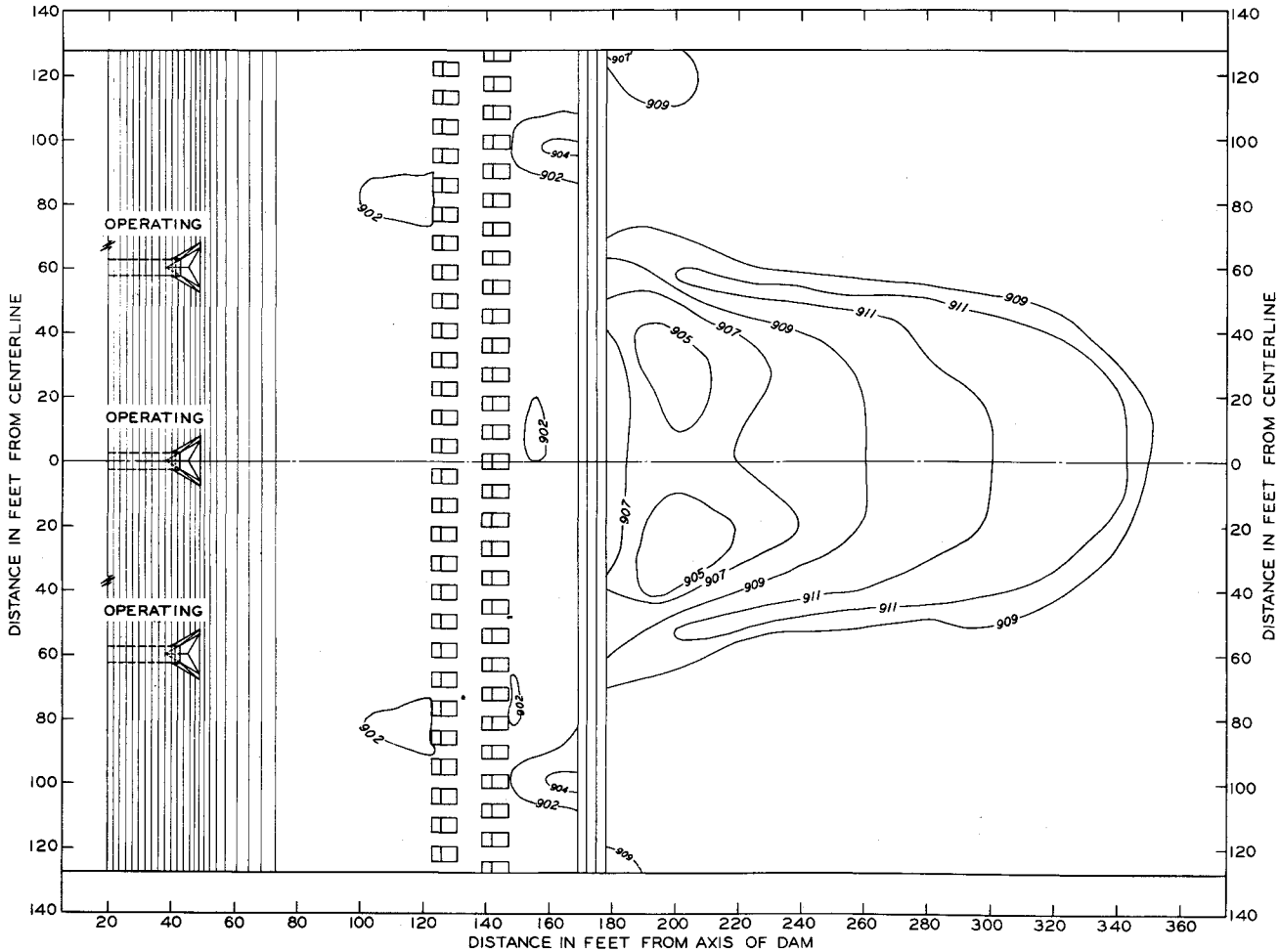
DISCHARGE	6,075 CFS
POOL ELEV	962.5
TAILWATER ELEV	917.3
TYPE 2 BASIN	
TYPE 2 SLUICE	

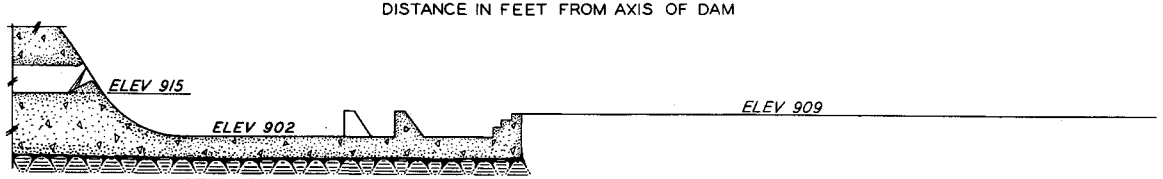
NOTE: BED OF EXIT CHANNEL FIXED IN CEMENT MORTAR AT ELEVATION 909.0

MODEL STUDY OF SLUICES
FALL RIVER DAM
FALL RIVER, KANSAS

BOTTOM VELOCITIES

PLATE 31





SECTION THROUGH CENTERLINE STILLING BASIN

TEST CONDITIONS

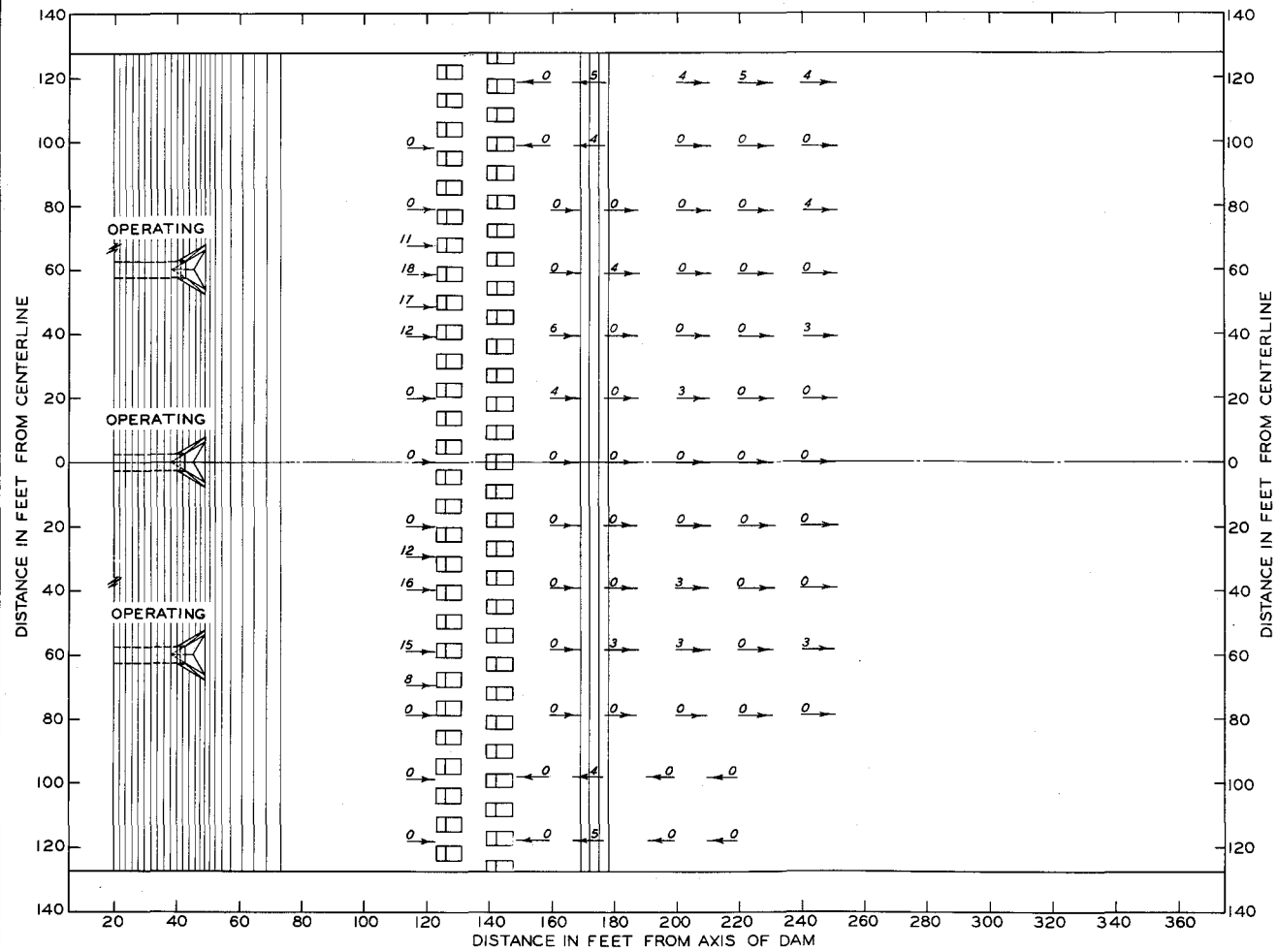
DISCHARGE	6,075 CFS
POOL ELEV	962.5
TAILWATER ELEV	917.3
TYPE 2 BASIN	
TYPE 2 SLUICE	

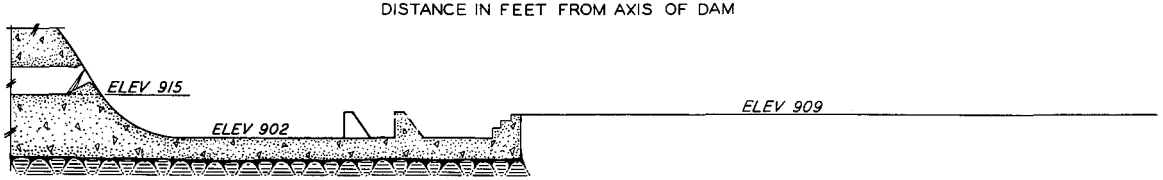
NOTE: BED OF EXIT CHANNEL MOLDED FLAT TO ELEVATION 909.0

MODEL STUDY OF SLUICES
FALL RIVER DAM
FALL RIVER, KANSAS

SCOUR PATTERN

PLATE 32





SECTION THROUGH CENTERLINE STILLING BASIN

TEST CONDITIONS

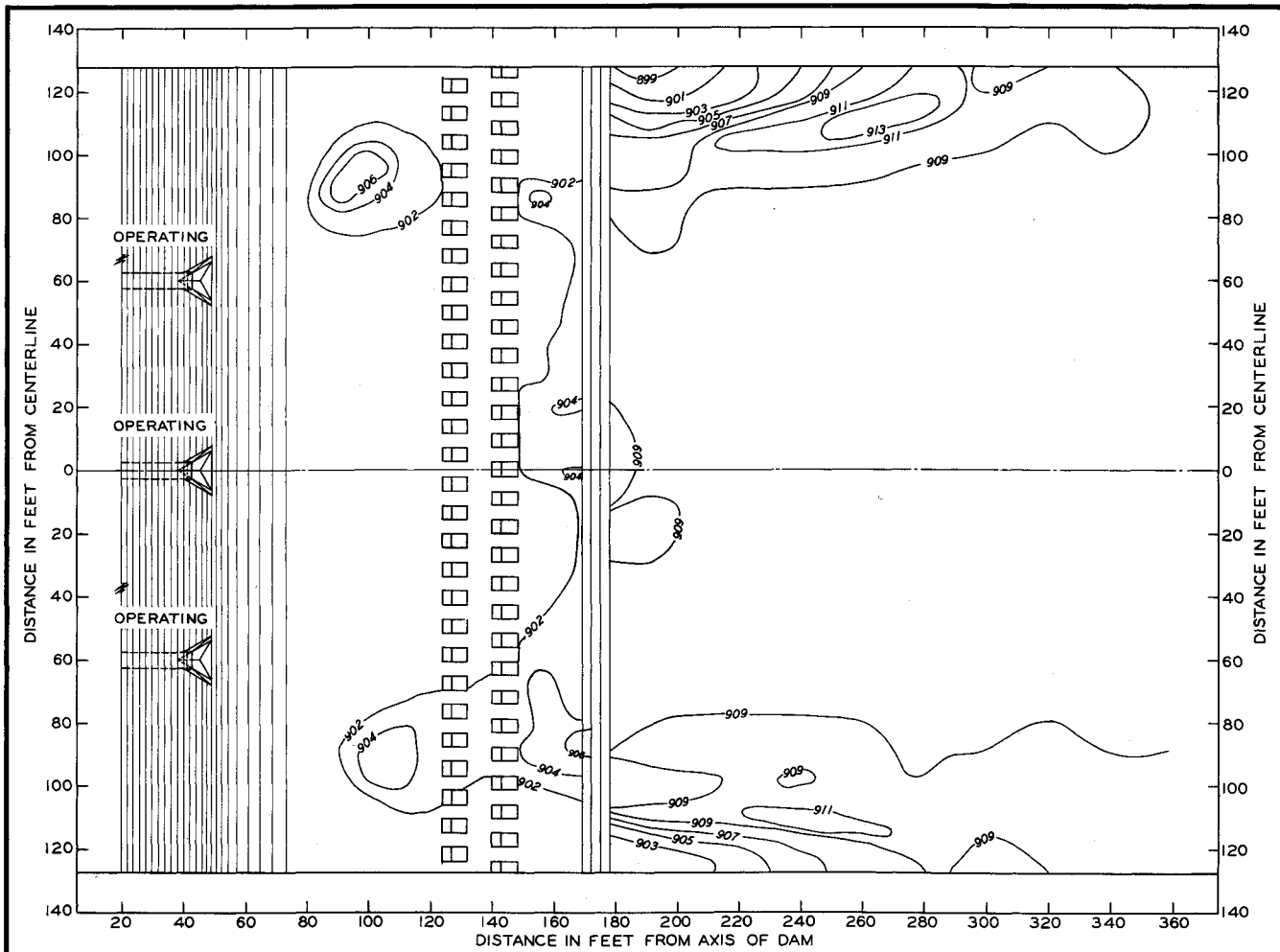
DISCHARGE	17,966 CFS
POOL ELEV	987.5
TAILWATER ELEV	925.8
TYPE 2 BASIN	
TYPE 2 SLUICE	

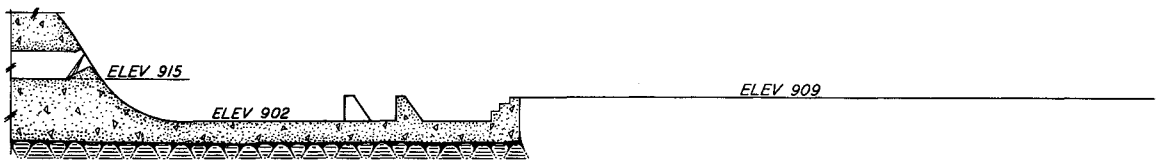
NOTE: BED OF EXIT CHANNEL FIXED IN CEMENT MORTAR AT ELEVATION 909.0.

MODEL STUDY OF SLUICES
FALL RIVER DAM
FALL RIVER, KANSAS

BOTTOM VELOCITIES

PLATE 33





SECTION THROUGH CENTERLINE STILLING BASIN

TEST CONDITIONS

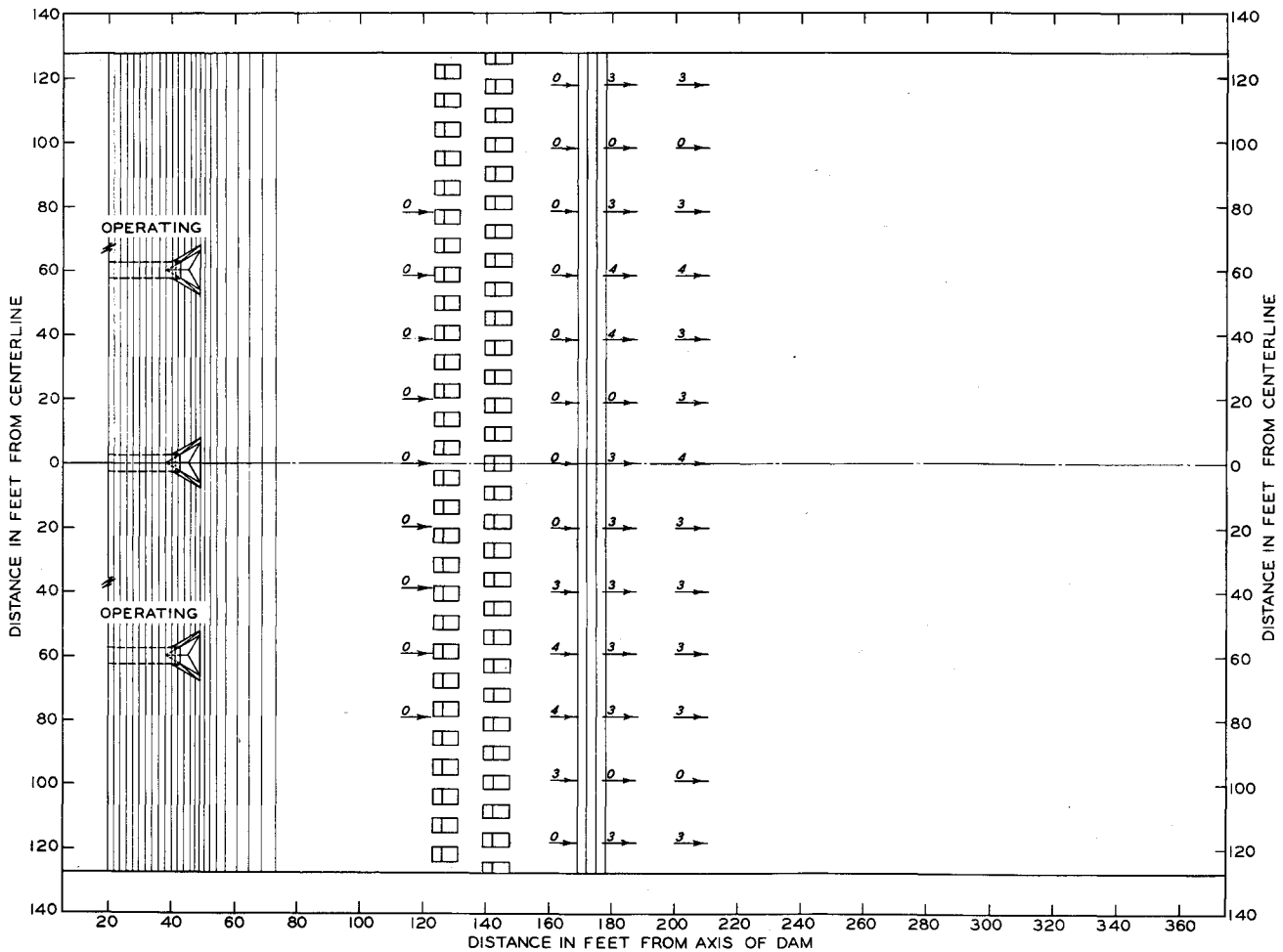
DISCHARGE	17,966 CFS
POOL ELEV	987.5
TAILWATER ELEV	925.8
TYPE 2 BASIN	
TYPE 2 SLUICE	

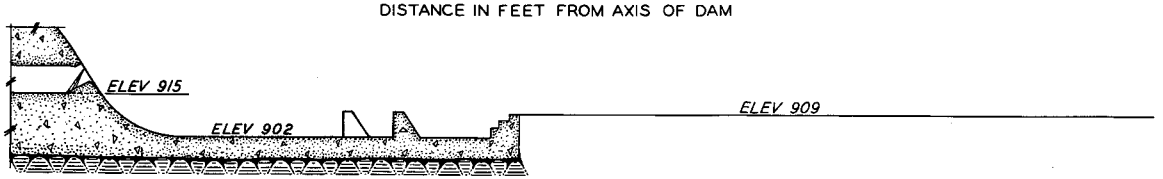
NOTE: BED OF EXIT CHANNEL MOLDED FLAT TO ELEVATION 909.0.

MODEL STUDY OF SLUICES
FALL RIVER DAM
FALL RIVER, KANSAS

SCOUR PATTERN

PLATE 34





SECTION THROUGH CENTERLINE STILLING BASIN

TEST CONDITIONS

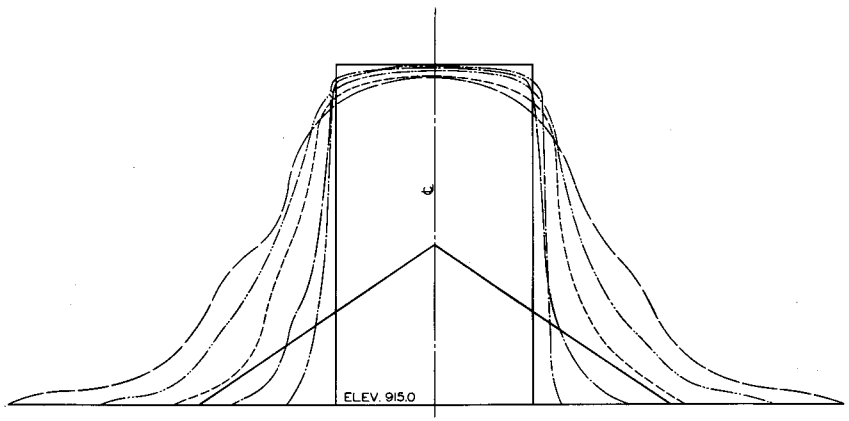
DISCHARGE	2,040 CFS
POOL ELEV	962.5
TAILWATER ELEV	912.3
TYPE 2 BASIN	
TYPE 2 SLUICE	
SLUICES 1 AND 3 HALF OPEN	

NOTE: BED OF EXIT CHANNEL FIXED IN CEMENT MORTAR AT ELEVATION 909.0.

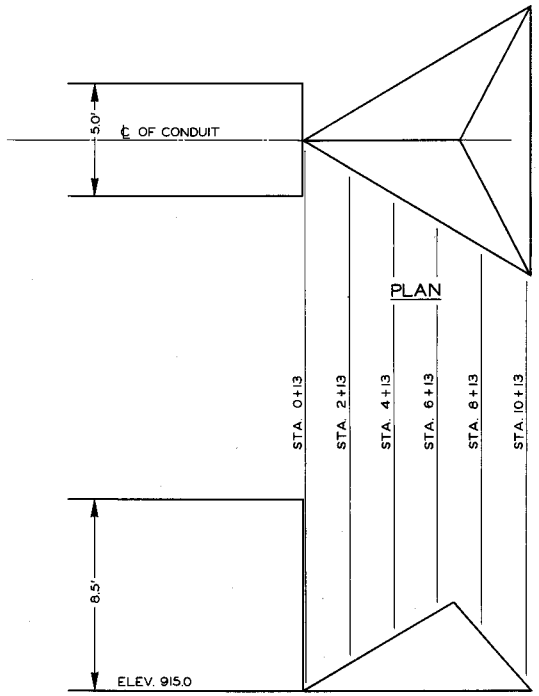
MODEL STUDY OF SLUICES
FALL RIVER DAM
FALL RIVER, KANSAS

BOTTOM VELOCITIES

PLATE 35



CROSS SECTION OF JET



ELEVATION

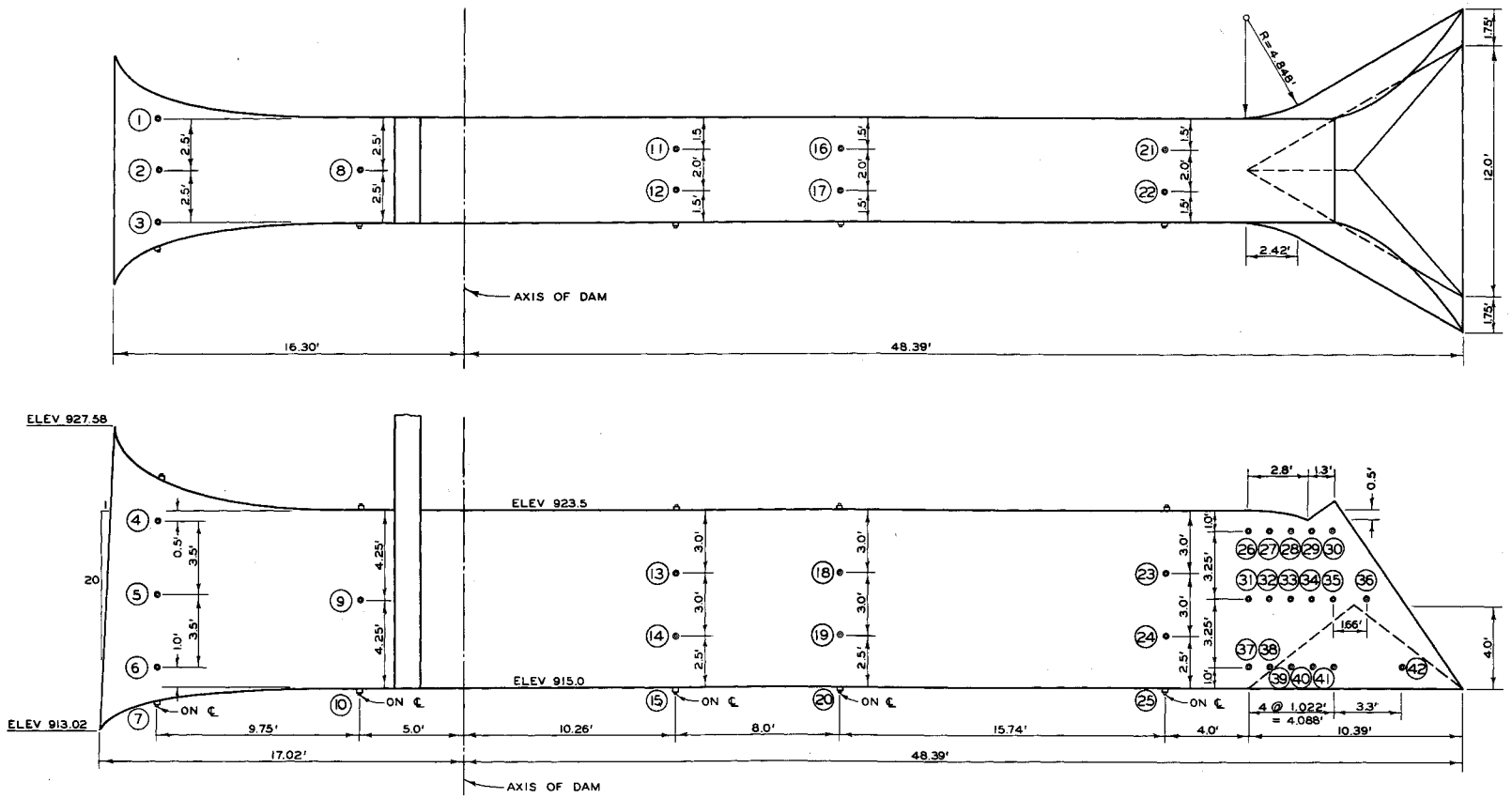
LEGEND

- STATION 0+13
- STATION 2+13
- STATION 4+13
- STATION 6+13
- STATION 8+13
- STATION 10+13

MODEL STUDY OF SLUICES
FALL RIVER DAM
FALL RIVER, KANSAS

CROSS-SECTION OF JET

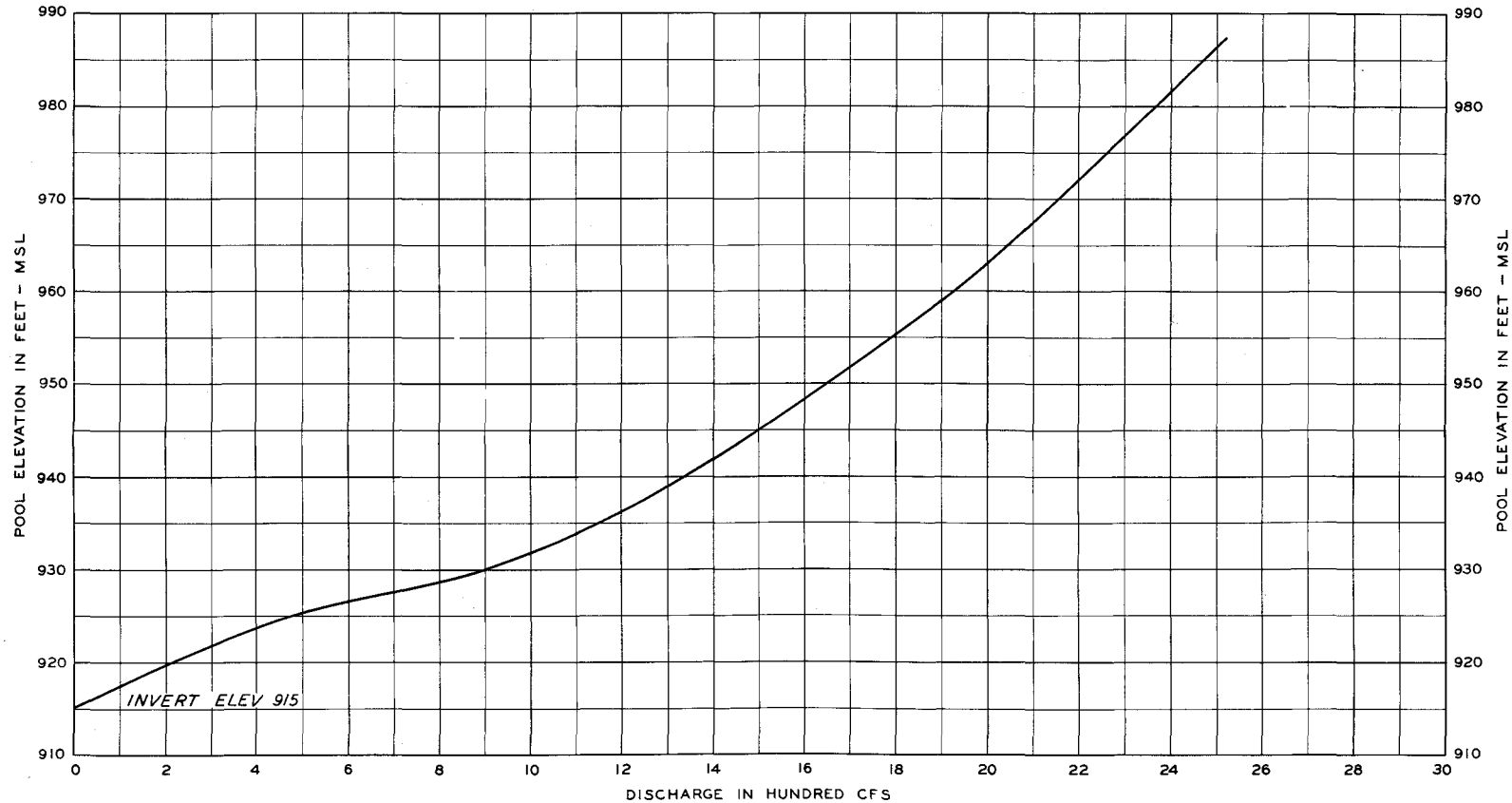
PLATE 36



MODEL STUDY OF SLUICES
FALL RIVER DAM
FALL RIVER, KANSAS

TYPE 6 DESIGN

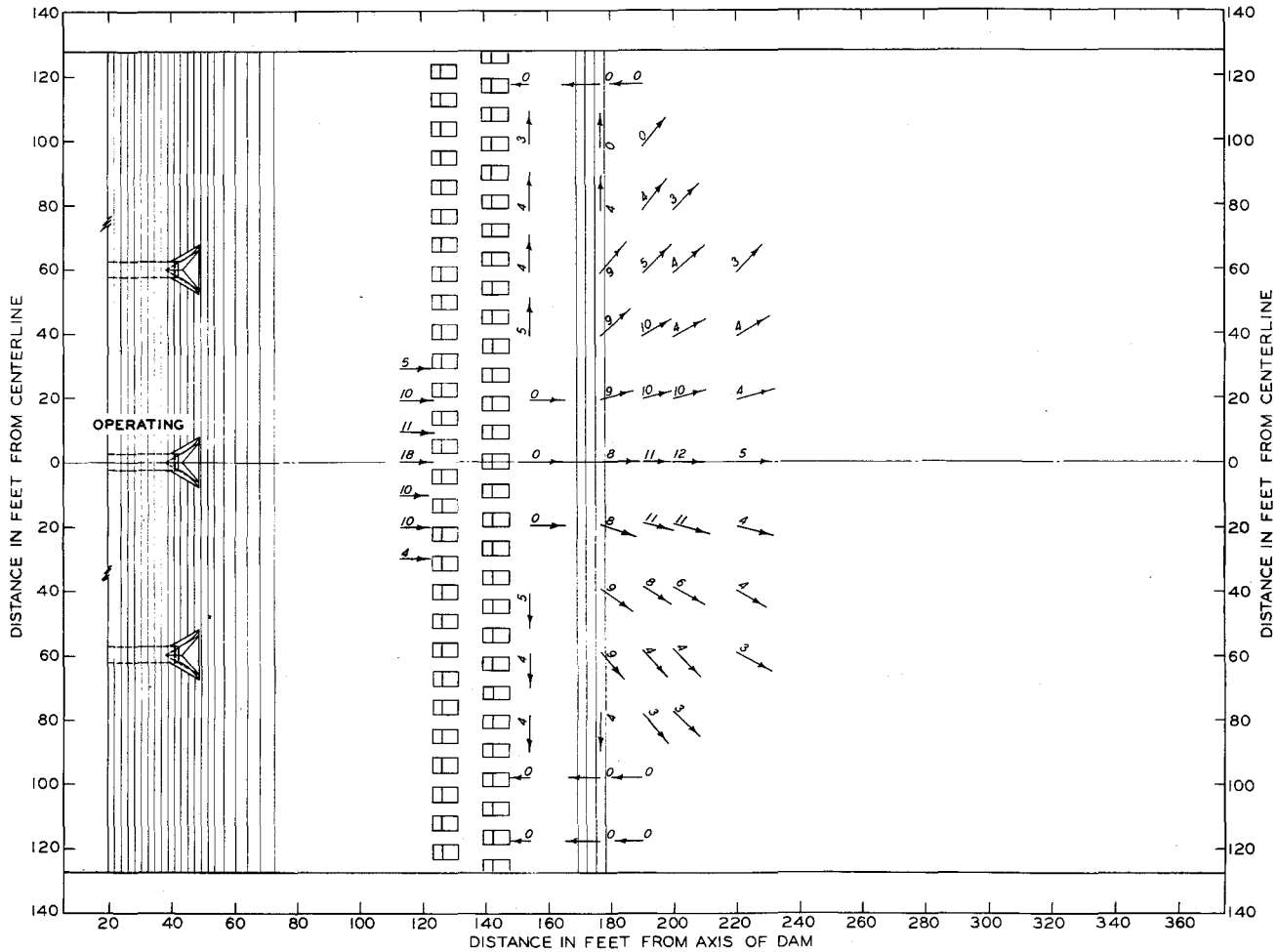
PLATE 37

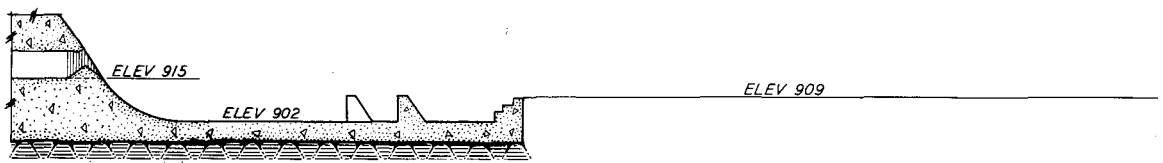


MODEL STUDY OF SLUICES
FALL RIVER DAM
FALL RIVER, KANSAS

SLUICE RATING CURVE
TYPE 6 DESIGN

PLATE 38





SECTION THROUGH CENTERLINE STILLING BASIN

TEST CONDITIONS

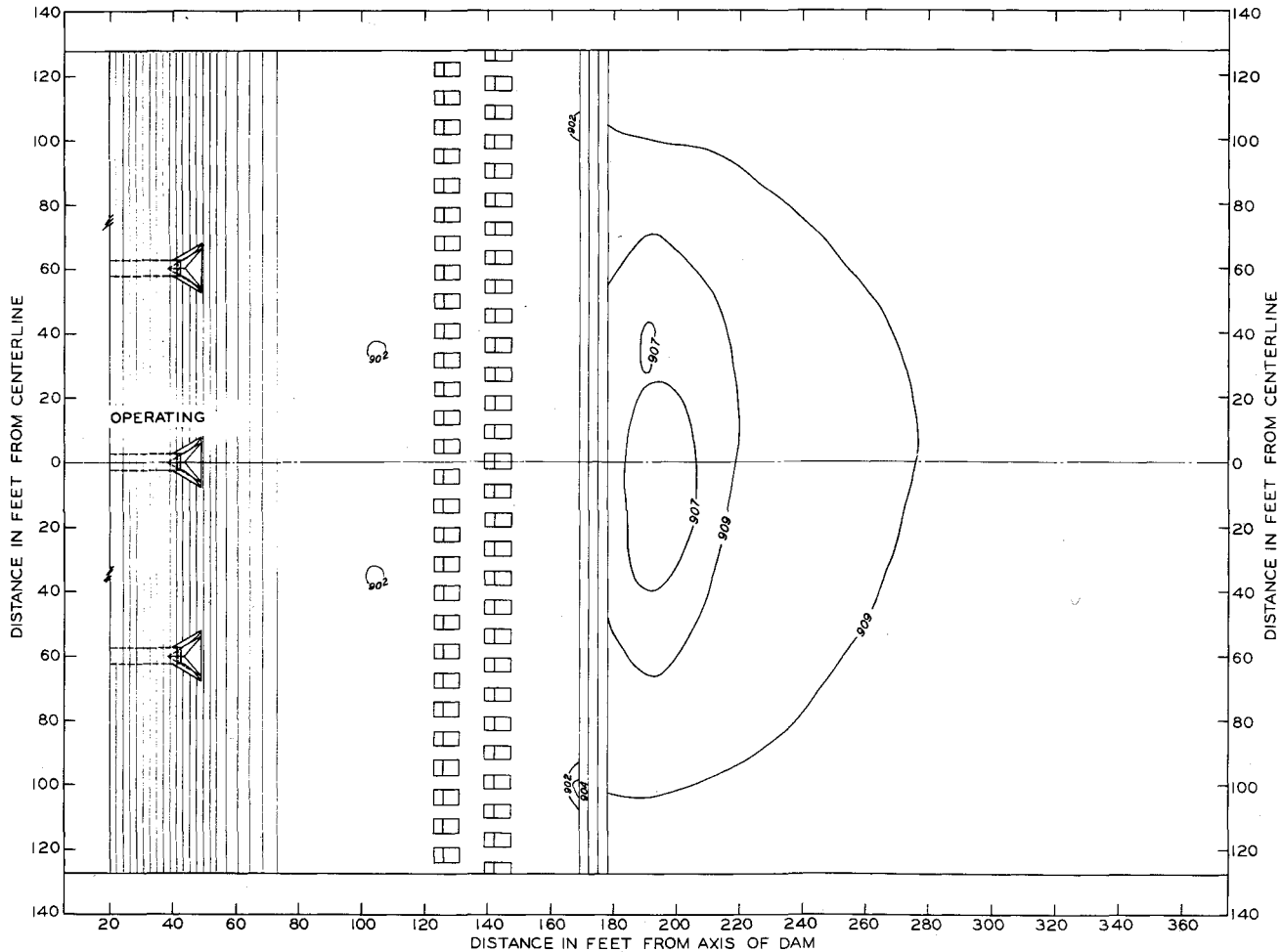
DISCHARGE	1,610 CFS
POOL ELEV	948.5
TAILWATER ELEV	911.5
TYPE 2 BASIN	
TYPE 6 SLUICE	

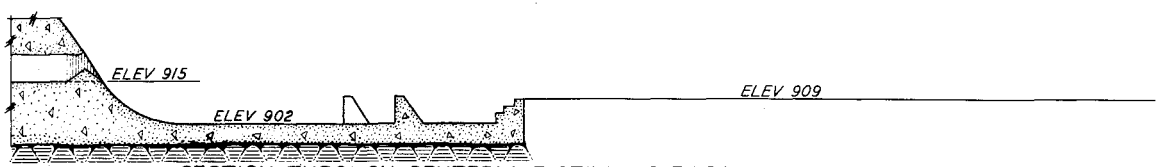
NOTE: BED OF EXIT CHANNEL FIXED IN CEMENT MORTAR AT ELEVATION 909.0.

MODEL STUDY OF SLUICES
FALL RIVER DAM
FALL RIVER, KANSAS

BOTTOM VELOCITIES

PLATE 39





SECTION THROUGH CENTERLINE STILLING BASIN

TEST CONDITIONS

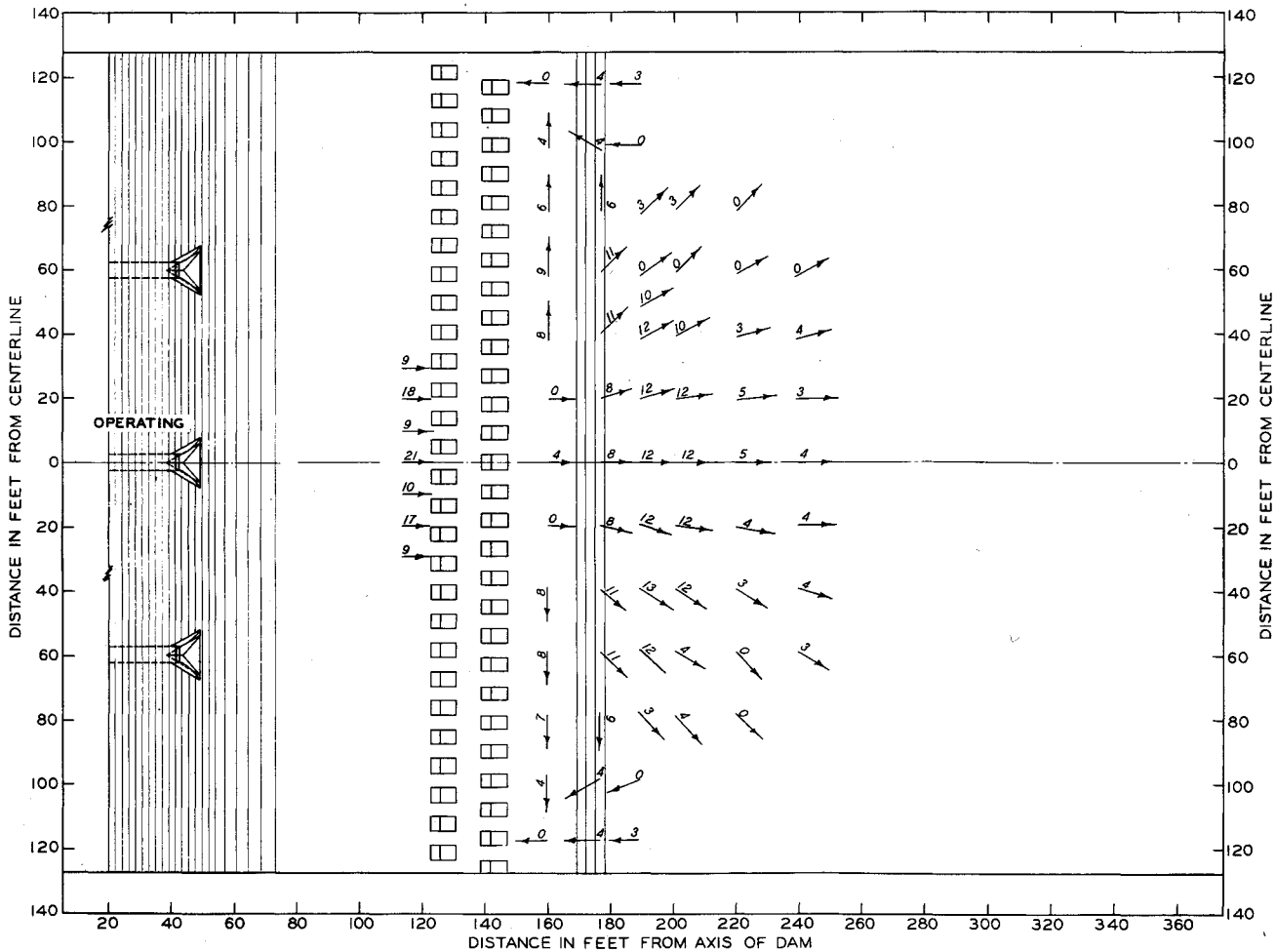
DISCHARGE	1,610 CFS
POOL ELEV	948.5
TAILWATER ELEV	911.5
TYPE 2 BASIN	
TYPE 6 SLUICE	

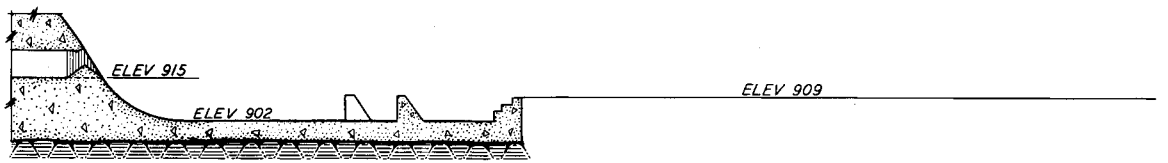
NOTE: BED OF EXIT CHANNEL MOLDED FLAT TO ELEVATION 909.0.

MODEL STUDY OF SLUICES
FALL RIVER DAM
FALL RIVER, KANSAS

SCOUR PATTERN

PLATE 40





SECTION THROUGH CENTERLINE STILLING BASIN

TEST CONDITIONS

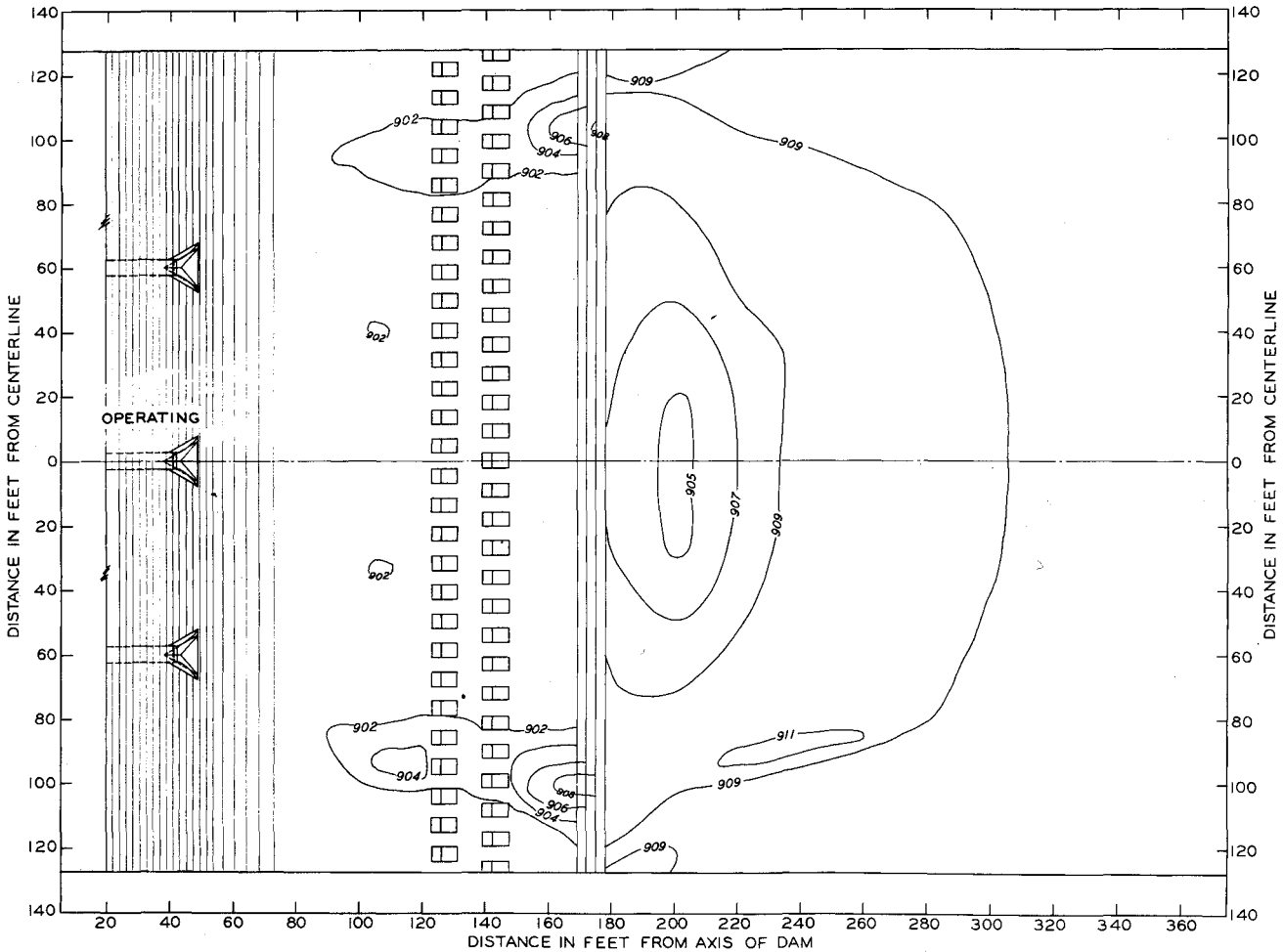
DISCHARGE	1,990 CFS
POOL ELEV	962.5
TAILWATER ELEV	912.2
TYPE 2 BASIN	
TYPE 6 SLUICE	

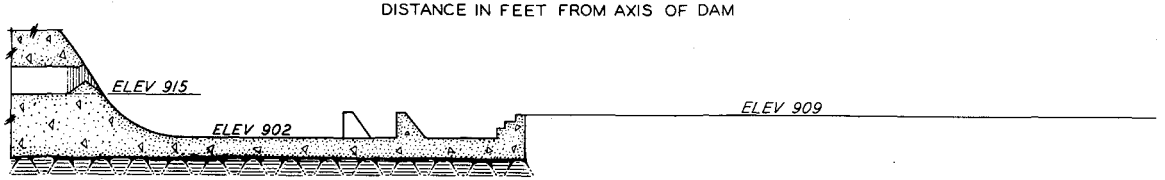
NOTE: BED OF EXIT CHANNEL FIXED IN CEMENT MORTAR AT ELEVATION 909.0.

MODEL STUDY OF SLUICES
FALL RIVER DAM
FALL RIVER, KANSAS

BOTTOM VELOCITIES

PLATE 41





SECTION THROUGH CENTERLINE STILLING BASIN

TEST CONDITIONS

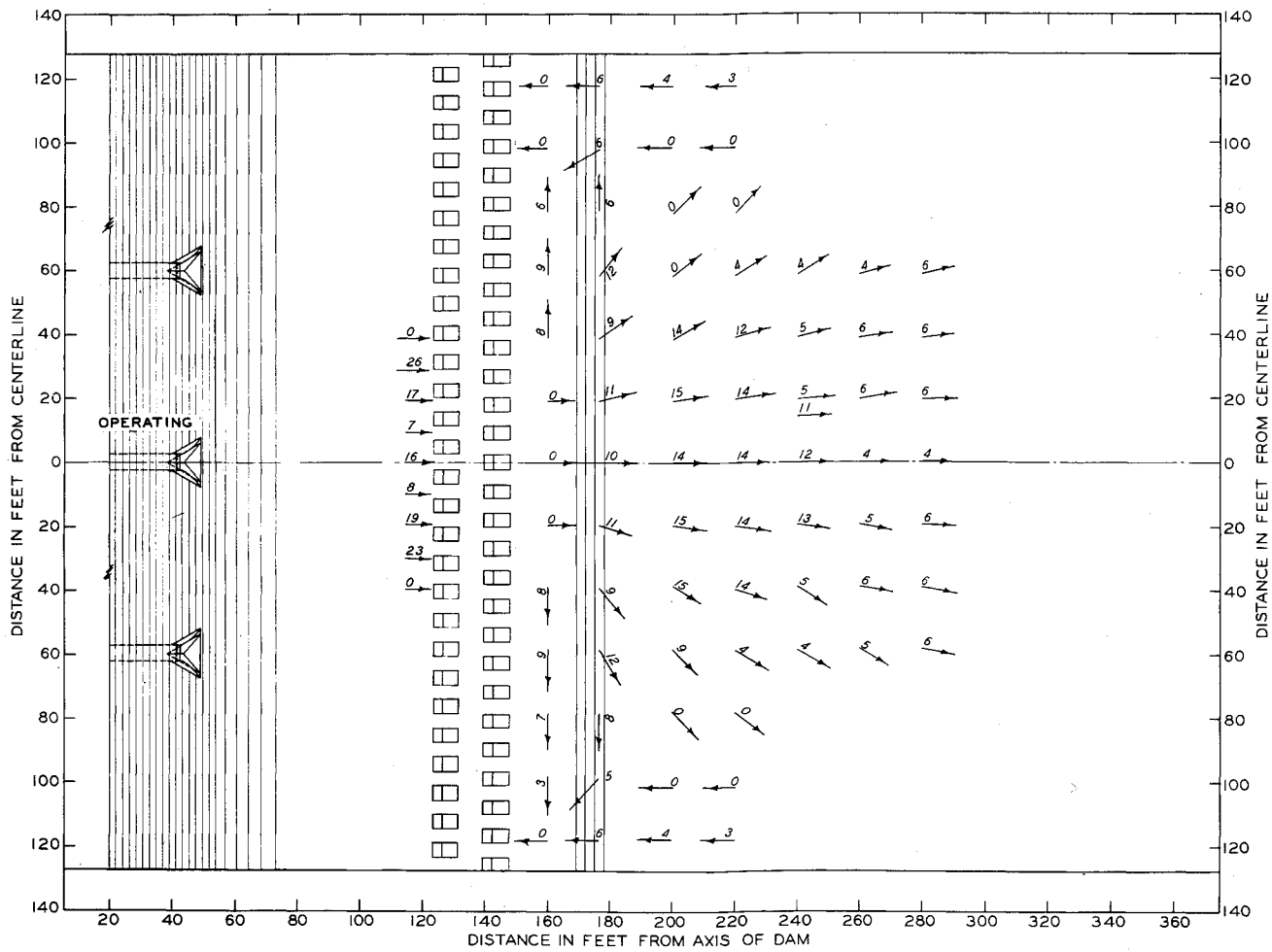
DISCHARGE	1,990 CFS
POOL ELEV	962.5
TAILWATER ELEV	912.2
TYPE 2 BASIN	
TYPE 6 SLUICE	

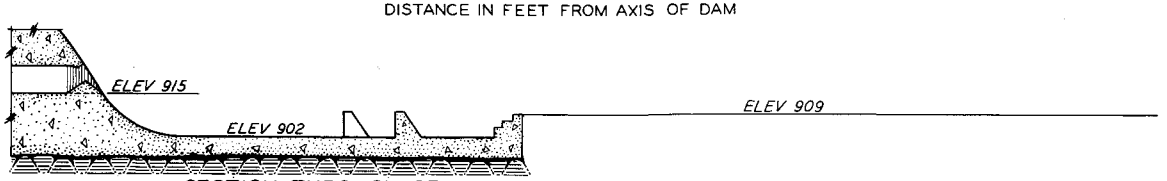
NOTE: BED OF EXIT CHANNEL MOLDED FLAT TO ELEVATION 909.0

MODEL STUDY OF SLUICES
FALL RIVER DAM
FALL RIVER, KANSAS

SCOUR PATTERN

PLATE 42





SECTION THROUGH CENTERLINE STILLING BASIN

TEST CONDITIONS

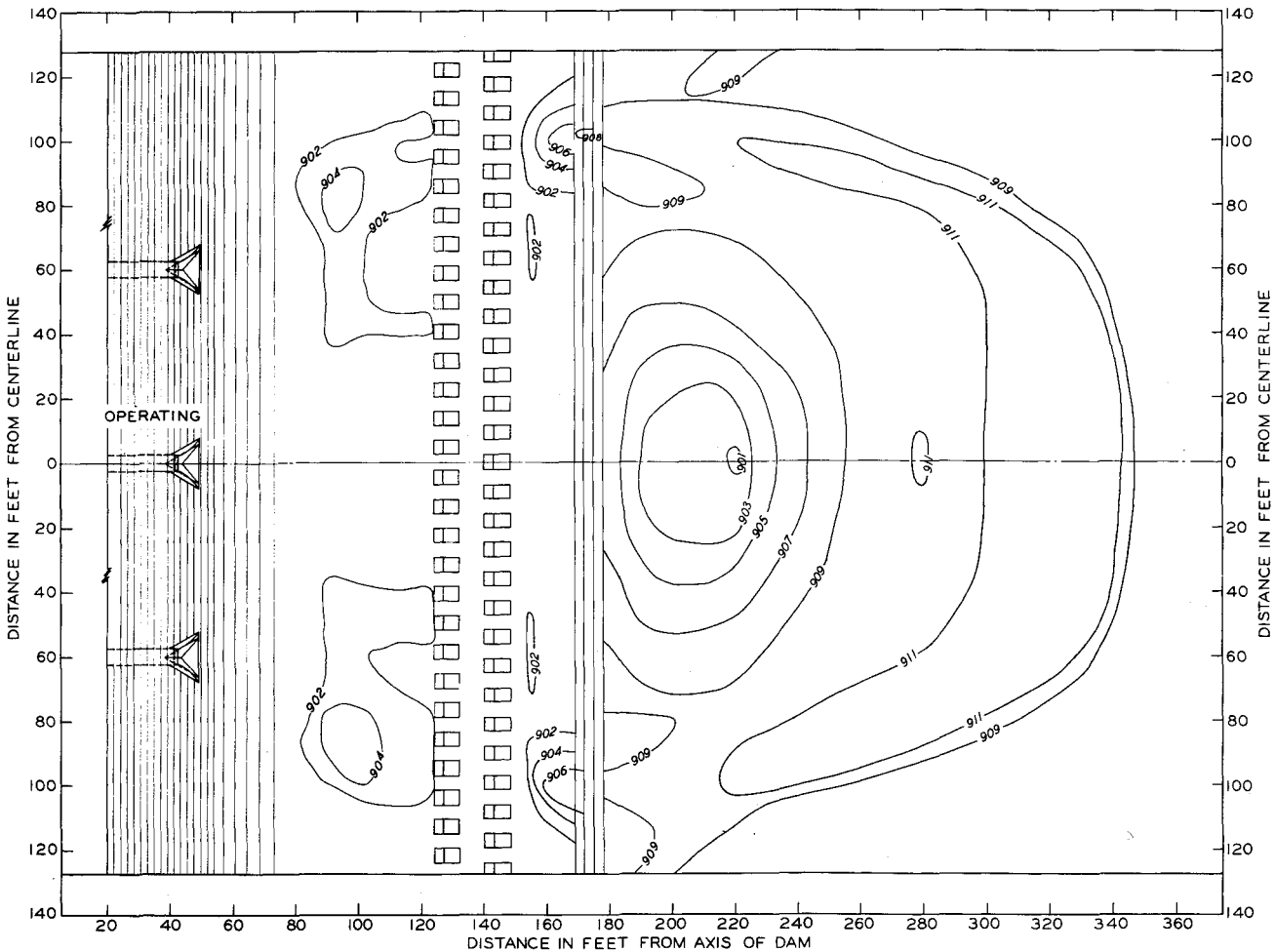
DISCHARGE	2,520 CFS
POOL ELEV	987.5
TAILWATER ELEV	912.8
TYPE 2 BASIN	
TYPE 6 SLUICE	

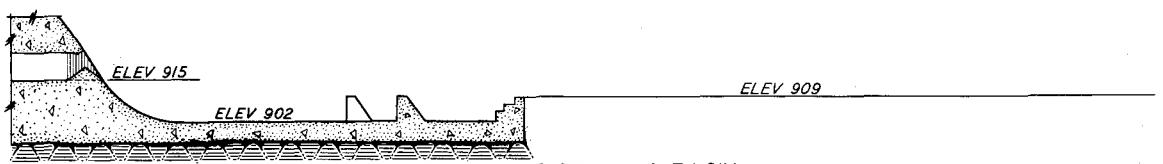
NOTE: BED OF EXIT CHANNEL FIXED IN CEMENT MORTAR AT ELEVATION 909.0.

MODEL STUDY OF SLUICES
FALL RIVER DAM
FALL RIVER, KANSAS

BOTTOM VELOCITIES

PLATE 43





SECTION THROUGH CENTERLINE STILLING BASIN

TEST CONDITIONS

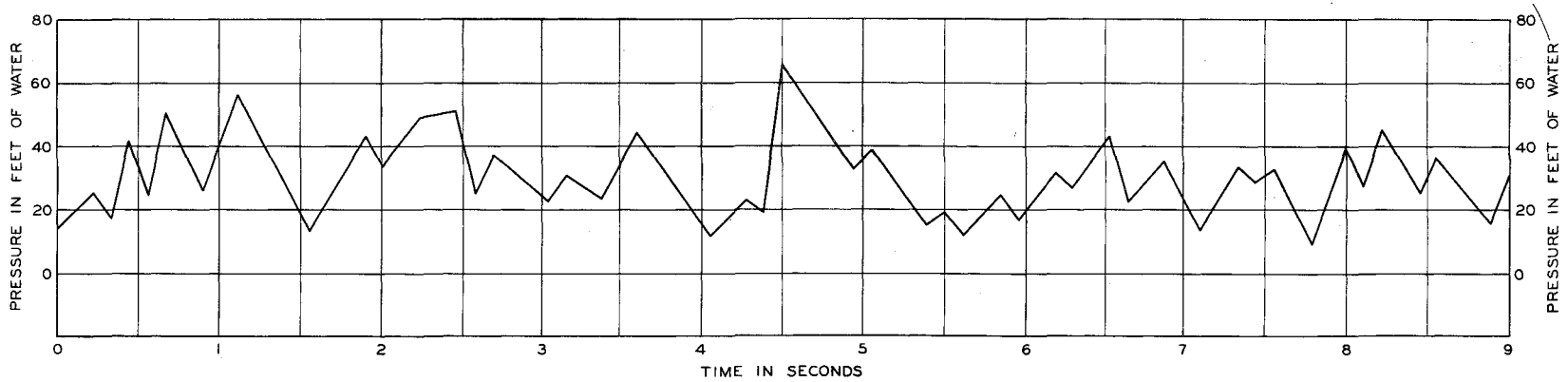
DISCHARGE	2,520 CFS
POOL ELEV	987.5
TAILWATER ELEV	912.8
TYPE 2 BASIN	
TYPE 6 SLUICE	

NOTE: BED OF EXIT CHANNEL MOLDED FLAT TO ELEVATION 909.0.

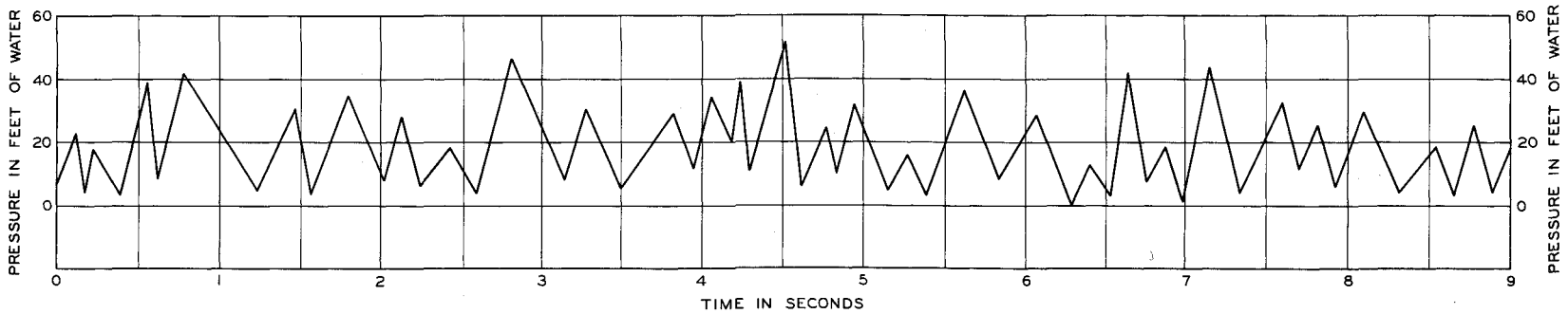
MODEL STUDY OF SLUICES
FALL RIVER DAM
FALL RIVER, KANSAS

SCOUR PATTERN

PLATE 44



TYPE 1 SLUICE



TYPE 6 SLUICE

TEST CONDITIONS - TYPE 1 SLUICE

DISCHARGE	2,400 CFS
POOL ELEVATION	987.5
TAILWATER ELEVATION	912.8
TYPE 2 BASIN	

TEST CONDITIONS - TYPE 6 SLUICE

DISCHARGE	2,520 CFS
POOL ELEVATION	987.5
TAILWATER ELEVATION	912.8
TYPE 2 BASIN	

NOTE: PRESSURES WERE OBTAINED THROUGH A PRESSURE CELL, IN THE UPSTREAM FACE OF A BAFFLE PIER, AND RECORDED BY MEANS OF AN OSCILLOGRAPH.

THE CELL IN FRONT OF THE TYPE 1 SLUICE WAS AT ELEVATION 904.6.

THE CELL IN FRONT OF THE TYPE 6 SLUICE WAS AT ELEVATION 907.4.

MODEL STUDY OF SLUICES
FALL RIVER DAM
FALL RIVER, KANSAS

PRESSURE FLUCTUATIONS ON BAFFLE PIERS

PLATE 45